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JULY – AUGUST 2025

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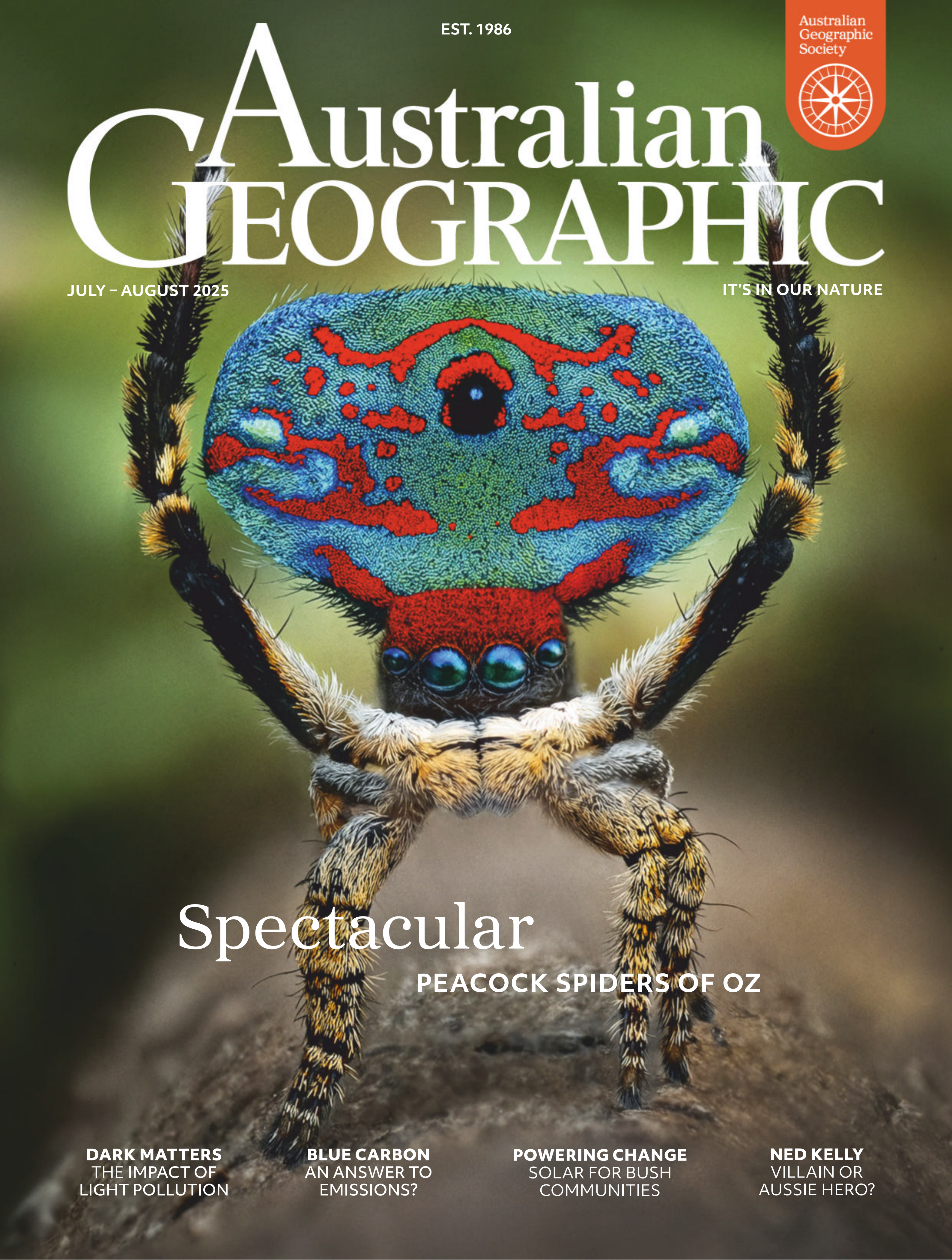

Spectacular

PEACOCK SPIDERS OF OZ

DARK MATTERS
THE IMPACT OF LIGHT POLLUTION

BLUE CARBON
AN ANSWER TO EMISSIONS?

POWERING CHANGE
SOLAR FOR BUSH COMMUNITIES

NED KELLY
VILLAIN OR AUSSIE HERO?

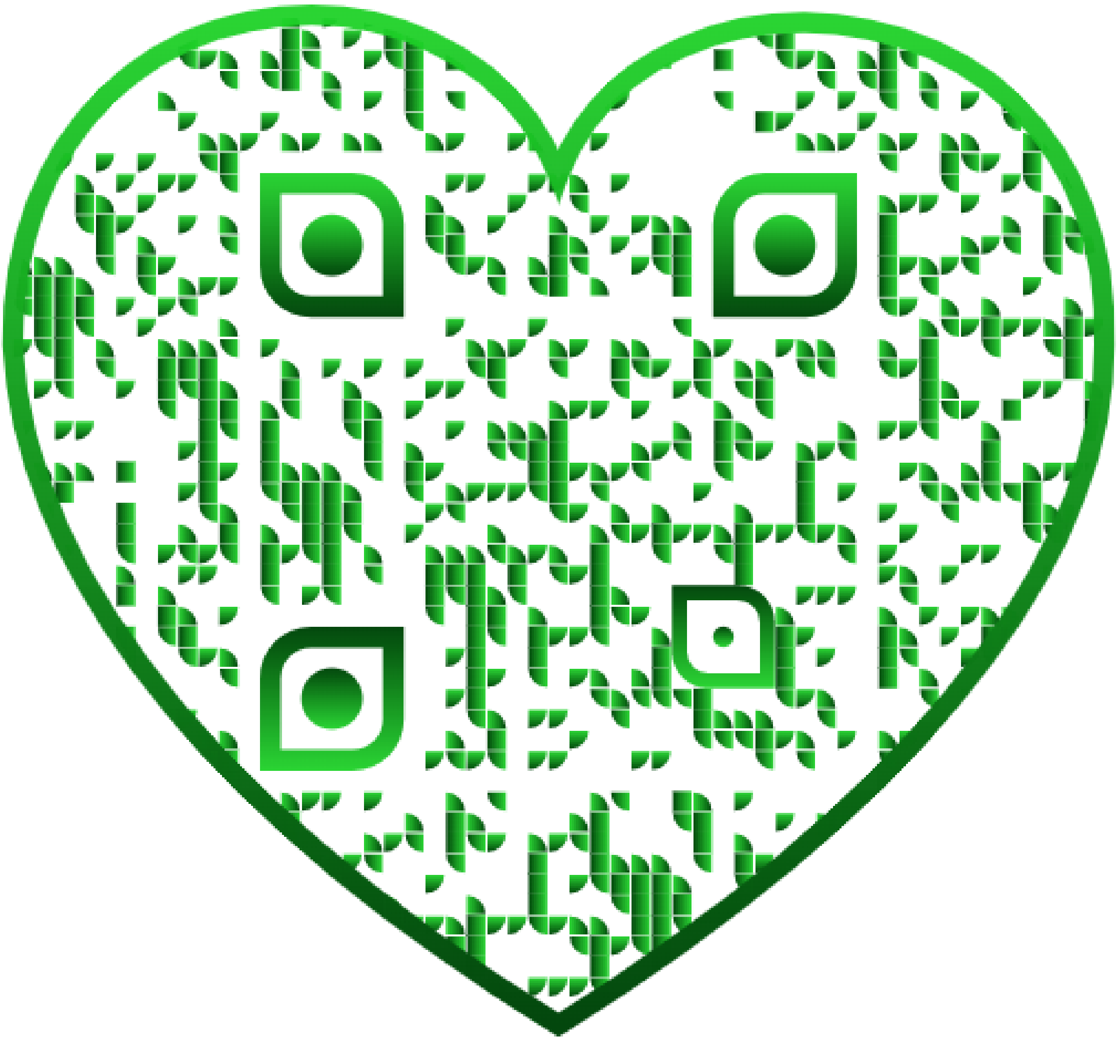

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PHOTO CREDIT: ALEX PIKE

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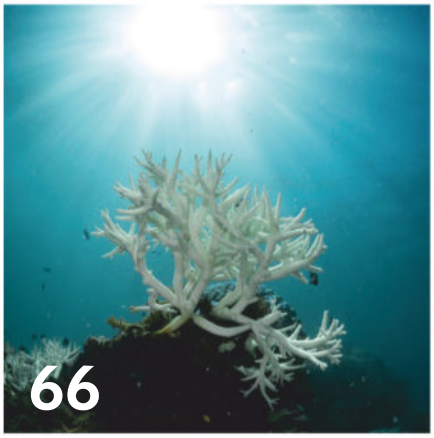
Australian Geographic Society

YOUR SOCIETY Find out where your donations are going in 2025 and get the latest news. **p28**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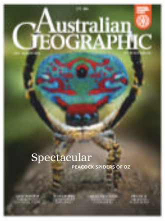
Special note: Members of First Nations communities are warned that this edition of Australian Geographic may contain images and names of deceased people.

PHOTO CREDITS, CLOCKWISE FROM TOP LEFT: CHARLES BROOKS; STEPHANIE SIMCOX; ALAMY; OLA GARPENDAL; BROOKE PYKE



ON OUR COVER

Michael Lun captured this stunning image of a male *Maratus madelineae* peacock spider in Collie, Western Australia. Its abdomen and legs are raised in a dazzling courtship display. Cover retouching by Tammy White.

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FROM THE EDITOR-IN-CHIEF

The natural solution

NATURE IS THE answer. That's no longer just a passionate reaction from extreme environmentalists or fringe radicals from the hippie movement. It's fast becoming a well-considered, fact-based and increasingly monetised response to the massive issues facing the planet.

The IPCC (Intergovernmental Panel on Climate Change) began including so-called nature-based solutions as a fundamental message in their regular assessments about a decade ago. They're now starting to be embraced – often as a necessity – in the policies of governments, including our own, the world over. And major insurers and huge industrial corporations have begun to seriously factor them into their spreadsheets and futureproofing accounting methods. Read between the lines in annual report after annual report and you'll realise that our CEOs and CFOs are coming around to the belief that an important part of the solution for the planet's many problems is to look within and trust the way earth has dealt with pressures over millions of years.

I recently saw how that might play out as part of a real-world response at two locations in Australia (see *Bringing in the sea*, page 80.) Yes, it's complicated and complex. Yes, it requires a great deal of conciliatory cooperation. But it looks to be doable, if the blue carbon projects I saw in South Australia and Queensland are anything to go by.

The same sort of science-rich, community-based, cooperative approach is what's now being seen as the way forward in the Illawarra region of New South Wales as it transitions from a century-long coal-fired economy to a more green-based, sustainable one. It's another very positive response that we explore in great detail in this issue (see *Green is the new black*, page 98).

As you'd know, we're not only going to bring you deep, thought-provoking issue-based reads. Often, we very happily just celebrate the sheer beauty of the world around us. And that's very evident in our story on peacock spiders, an almost exclusively Australian group of jumping spiders (see *More than meets the eye*, page 44). I defy anyone to look at our images of these tiny and spectacular creatures and not feel good about the world.

There's also much joy in the extraordinarily beautiful images taken by Melbourne-based photographer Charles Brooks (see *Music's hidden realm*, page 90). We were there when he recently photographed inside a fully functioning Stradivarius violin for the first time in history. The results will amaze you.

K McGhee

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AUSGEO TRAVEL

Growing up in Bundaberg and surrounded by cane fields and sandy beaches, it was the stories of the outback that captured my imagination. Names like Charleville, Cunnamulla, St George and Longreach sounded distant and dusty, yet they held a kind of magic. These weren't just towns – they were gateways to Australia's spirit. I'd hear about the railways, the stock routes, the early aviators and explorers who passed through them, shaping our nation's story. Even as a kid, I sensed their importance. They were part of what made Australia bold, resilient and uniquely itself.

Bryan Arnicar
General Manager
Australian Geographic Travel

The Cunnamulla Fella statue honours Aussie bushmen.

PHOTO CREDIT: OUTBACK QUEENSLAND TOURISM ASSOCIATION

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NOTES FROM THE FIELD

Photographer Alex Pike crouches to get the perfect shot of a red-necked stint.

PHOTO CREDIT: TJANI WILSON BUCKSKIN

Of mangroves and mudflats

WE WANTED SOMEONE who could shoot equally well above and below water for our story on blue carbon (see *Bringing in the sea,* page 80), and photographer Alex Pike was perfect for that assignment.

"You'd never think the landscape north of Adelaide hides something as special as the Adelaide International Bird Sanctuary National Park – Winaityinaityi Pangkara," Alex says. "Late one afternoon, our guides from The Nature Conservancy, Kylie Moritz and Abby Goodman, promised the perfect spot to photograph mangroves partially submerged at low tide. We'd barely rolled into the gravel car park before I was racing past the corrugated fences of nearby homes (cheered on by a barking kelpie), through the scrub, to lose myself in the most fantastic mangrove forests I've ever seen.

"In that afternoon light I explored the clear, shallow flats and deep channels, navigating grey mangrove roots and hardy saplings defying the harsh saline environment. It wasn't until the next morning, viewing the coastline from the air with a drone, that I grasped the scale of the coastal vegetation here – an expanse of mangroves running parallel with the coast, as far as the eye could see, while also stretching inland.

"At low tide, the water receded for kilometres, giving way to sprawling tidal flats and revealing a banquet for thousands of shorebirds. Crouching silently while I waited for a flock of red-necked stints to forage in my direction, I was reminded of how the rhythms of intertidal ecosystems are taken to such an extreme in this environment."

Regular columnists: Glenn Dawes, Bruce Elder, Dr Karl Kruszelnicki AM, Kel Richards, Roger Smith, Fred Watson AM, Tim the Yowie Man

More contributors: Carolyn Beasley, Charles Brooks, Violeta Jahnel Brosig, Tjani Wilson Buckskin, Kate Dodds, Amanda Freeman, Ola Garpendal, Juno Gemes, Laura Gourgas, Ed Hurst, Michael Lun, Mandy McKeesick, James Moore, Rachel Mounsey, Lee Mylne, Marnie Ogg, Jurgen Otto, Alex Pike, Flynn Prall, Brooke Pyke, Nicole Reed, Chris Round, Stephanie Simcox, David Stowe, Clare Watson, Duncan Wright

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YOUR SAY

For the love of animals

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FEATURED LETTER

Thank you for the Australian Portrait article about Dr Danielle Celermajer, the professor of sociology and criminology who champions rights for non-human animals (AG 186). I thought it was a very important article. I feel very strongly about being kind to non-human animals and hope that your article will inspire more people to dedicate efforts towards preventing cruelty and improving the lives of other animals. I feel particularly strongly about the need to reduce meat consumption and change factory farming. I think also that there should be more efforts to educate the general public about this. Not only can we then prevent more animal cruelty, but we can also reduce the methane that's contributing to climate change. Science education is crucial: when we understand that we are related to non-human animals, that we are not separate from and above them, but have a shared past and are all interconnected, we become more willing to see something of us in them and stop our wilful blindness.

Caroline Grimpen, Bardon, QLD

APPLES AND ORANGES

I want to point out a commonly made error in AG 184. On page 100, the fruit that Megan James is picking is a 'mandarine', not a 'mandarin'. A 'mandarin' is someone like (the mythical) Sir Humphrey Appleby GCB KBE MVO from the TV programmes *Yes Minister* and *Yes, Prime Minister*.

As usual, though, this issue is a thoroughly good read. Thanks especially for the *Great Aussie Mysteries* segment.

Pete Grant, Bendigo, VIC

Ed's reply: *Spot on, Pete! Both spellings are accepted, but in our spelling reference (*Macquarie Dictionary*) 'mandarin' is the preferred spelling.*

MAD ABOUT MAPS

As a student teacher in the late 1960s attending the Australian School of Pacific Administration (which trained teachers for PNG and the NT) I was fortunate to have cartographer and geographer Edgar Ford as my geography lecturer. Together with Brock Rowe, Ford produced several high-school geography texts of the day.

Ford's maps were all in black and white, hand-drawn and hand-labelled, and of exceptional clarity. I continued to use his maps in my classes in PNG. Today, maps are mostly in colour, computer drawn and labelled and show too much information. Edgar Ford was of the belief that maps should support the text that accompanies them. I find that the maps in Australian Geographic mostly follow Edgar Ford's approach tocartography.

More maps please!

Noel Peters, Bayview Heights, QLD

TASSIE TIN

My father worked as a geologist in Tasmania and I was born there. Although Dad's work was focused around Zeehan on the west coast, your story on tin mining further east on the island (*Tasmania's forgotten Chinese history*, AG 185) resonated with me. Learning more about the Chinese people who came to Tasmania to mine its tin was fascinating. One question that Lee Mylne could have answered for your readers is why was tin so valuable? Unlike gold or silver its value is not so obvious. Adding this economic context to the article would have rounded it off nicely. Nonetheless I enjoyed Lee's story and more generally the whole magazine.

Alex Burger, Lane Cove, NSW

UNDER THE WEATHER

While storms have ravaged parts of our eastern seaboard, most of South Australia is experiencing severe drought conditions with many parts of the state recording their lowest rainfall on record. To make matters worse for South Aussies, a toxic algal bloom – caused by warm waters along the

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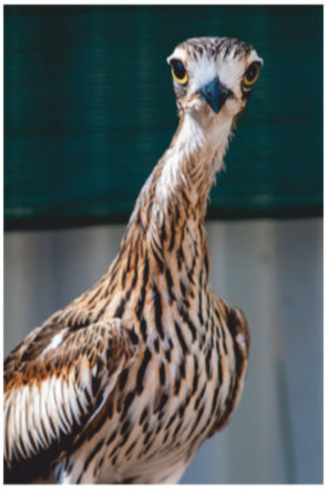
shores of the Eyre and Yorke peninsulas and Kangaroo Island – has resulted in the deaths of huge numbers of fish, sharks and stingrays. The bloom, believed to be caused by toxic phytoplankton, depletes oxygen in the water and can suffocate marine life.

Peter Searcy, Mile End, SA

BIRDER'S PARADISE



I thank you and your wonderful team for yet another great edition (AG 185). I loved the bush stone-curlew story – they are around my house at West Point, Magnetic Island. There are red-tailed black cockatoos feeding on the ground off false olives, and 48 other birds I spot around here (I just heard kookaburras sharing a joke… must be a good 'un…). The gregarious friarbirds with their near-human calls and banter keep me entertained for hours, as do the busy little sunbirds. Yep, we have more than 200 types of birds that live on or visit Maggie [Magnetic Island], including some from faraway places like Eastern Siberia and the west coast of Alaska. (Gee, we must stop those terrible feral cats…)

How fortunate we are that AUSTRALIAN GEOGRAPHIC brings all this to us. Thank you.

David Ede, Magnetic Island, QLD

MARITIME MYSTERY

It was a shock to read a small article on the *Zuytdorp* shipwreck (Geobits, AG 185). It grabbed my attention straight away as it's a subject I'm very interested in. I didn't realise researchers from Flinders Uni were studying why or how the *Zuytdorp* became shipwrecked. After 20 odd years living in Kalbarri in the '90s and 2000s, I came to the same conclusion [that it was wrecked by a storm]. I have experienced how strong and hard these winds can be and understand the sailors had no hope of directing their ship away from the coast. It must have been very scary getting blown into a 300m-high cliff face with no control over their vessel.

There is still so much mystery about this ship and its survivors. Still to this day, there has been no evidence from any of the survivors anywhere in this remote area. Not a bone or European item has been found to prove they got any further than the shipwreck site.

The site is a no-go zone for the public, who risk a $20,000 fine if they're caught within 2–5km of the site. I know a few people who have coins from the *Zuytdorp* stashed never to be seen, as it is illegal to have any of these coins.

David Pratt, Vasse, WA

PHOTO CREDIT: ANNETTE RUZICKA

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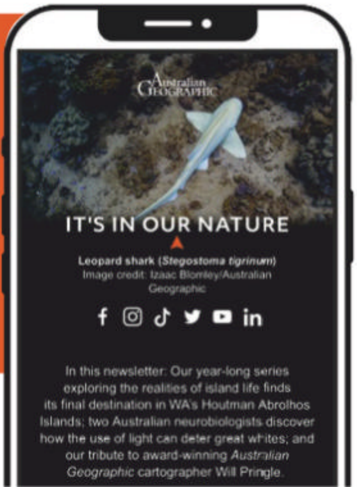


IT'S IN OUR NATURE

Leopard shark (*Stegostoma tigrinum*)
Image credit: Izaac Blomley/Australian Geographic

In this newsletter: Our year-long series exploring the realities of island life finds its final destination in WA's Houtman Abrolhos Islands; two Australian neurobiologists discover how the use of light can deter great whites; and our tribute to award-winning *Australian Geographic* cartographer Will Pringle.

LITTLE PATTIE

Our Instagram audience was moved by Patricia Amphlett's experience entertaining Aussie troops in the Vietnam War.

Billie Abbott
Lovely to see and listen to Little Pattie…Lest We Forget

Janette Crocombe
Thank you so much Pattie. Praise for being there for them. My former husband always talked about seeing you and Col on stage and how it lifted morale

Tara Venn
God bless you Pattie! What a Legend you are; artist, philosopher and sharer of all that is decent. Our history is important as are our stories. Thank you for your insight and all you've given!

Peter Young
Pat, Col, you have no idea how many times we all talked about your concerts for weeks and weeks. Thanks guys, Thanks

Kenneth Lyneham
Pattie, you were a darling in those days, you are now, and you always will be.

Tracy Pax
My dad loved that you went over when he was there, thank you. One of his happy memories.

Deb Gillies Hornby
Beautifully said Pattie. So thankful of you all. Xx

Caroline Kennedy
What a treasure!

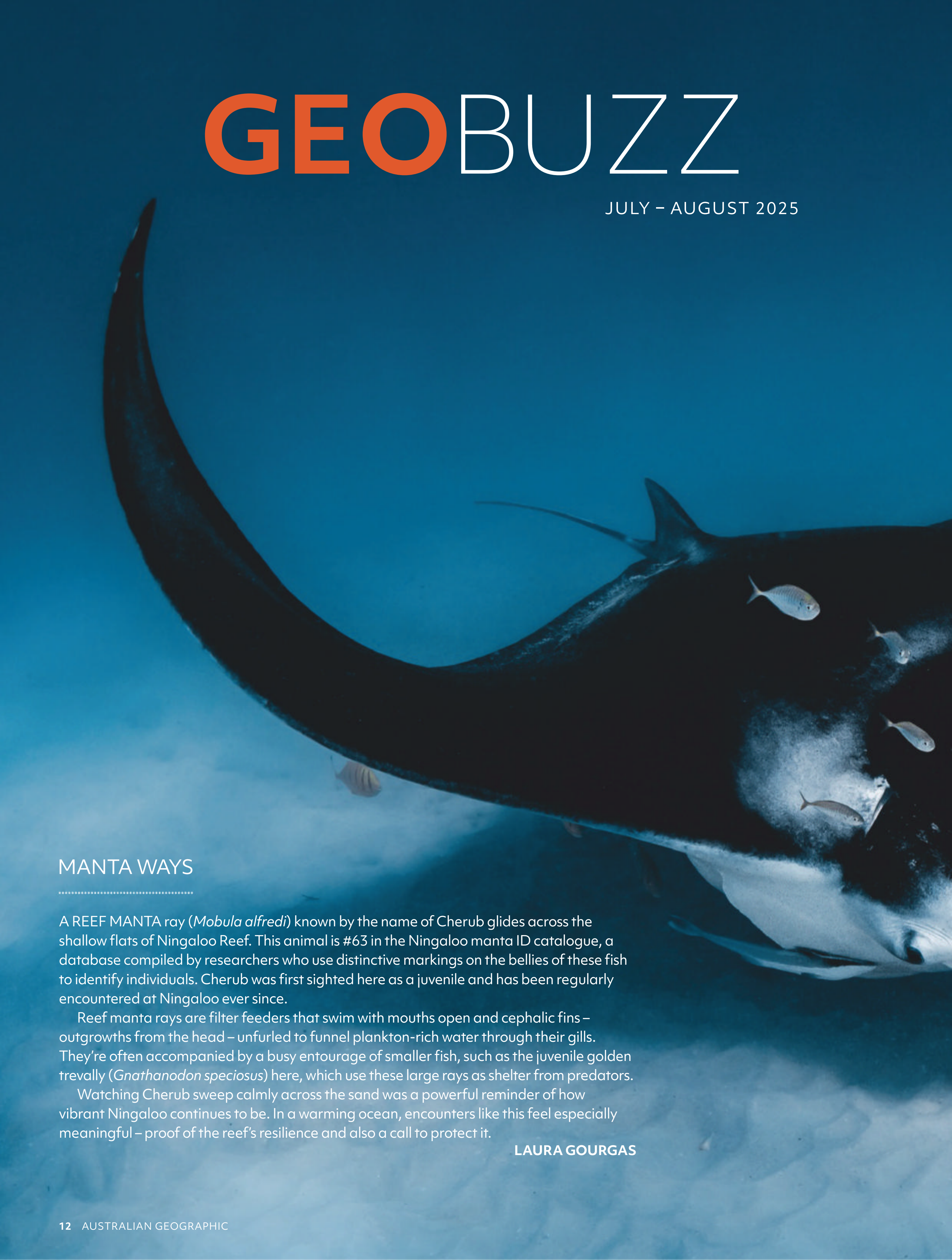
Karrianne Poswiat
I'm sure you made a lot of people happy that day xxx Well done

LEARN MORE

Scan the QR code to watch Little Pattie's full interview on our YouTube channel, or visit: *ausgeo.co/LittlePattie*

GEOBUZZ

JULY – AUGUST 2025



MANTA WAYS

A REEF MANTA ray (*Mobula alfredi*) known by the name of Cherub glides across the shallow flats of Ningaloo Reef. This animal is #63 in the Ningaloo manta ID catalogue, a database compiled by researchers who use distinctive markings on the bellies of these fish to identify individuals. Cherub was first sighted here as a juvenile and has been regularly encountered at Ningaloo ever since.

Reef manta rays are filter feeders that swim with mouths open and cephalic fins – outgrowths from the head – unfurled to funnel plankton-rich water through their gills. They're often accompanied by a busy entourage of smaller fish, such as the juvenile golden trevally (*Gnathanodon speciosus*) here, which use these large rays as shelter from predators.

Watching Cherub sweep calmly across the sand was a powerful reminder of how vibrant Ningaloo continues to be. In a warming ocean, encounters like this feel especially meaningful – proof of the reef's resilience and also a call to protect it.

LAURA GOURGAS

BIG PICTURE

The reef manta ray is one of the ocean's largest fish. Individuals can reach widths of 4.5m and a weight of 700kg. Photo by **Laura Gourgas**

GEOBITS

EDITED BY **ESME MATHIS**

The bold and the beautiful

New research from The University of Queensland confirms sea slugs with the brightest colouration and most eye-catching patterns are active during the daytime, when their appearance is at its most striking.

The study, published in the *Journal of Animal Ecology* and led by Dr Cedric van den Berg, analysed the colouration and pattern morphology of 45 diurnal and nocturnal east coast species.

"[Diurnal] sea slugs use bright, contrasting colour patterns to send messages to potential predators, like: 'Don't eat me, I'm poisonous!'" Dr van den Berg said.

Scientists have long suspected a link between bold visual signals and daytime activity, but there was "surprisingly little evidence" to back this assumption until now, Dr van den Berg said.

"They advertise their underlying defences, such as nasty chemicals or stinging cells, with bold visual signals like brightly coloured spots, thick stripes and enhanced body outlines. These tactics are strongly linked to being active during daytime when there's enough light for these signals to function," he said.

"Nocturnal sea slugs don't need to evolve colours and patterns aimed at signalling to potential predators, because predators are unlikely to use vision to hunt at night when senses like touch and smell are more important."

Diurnal sea slugs warn off potential predators with their bright colours and striking patterns.

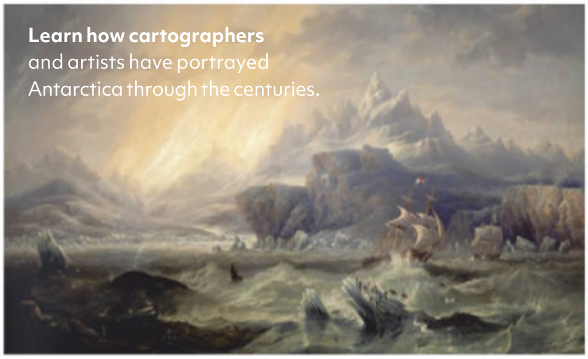
Southern Frontiers cartography conference

Explore the cartographic history of the Southern Hemisphere at the Southern Frontiers: Mapping Myths and Realities conference, hosted by the Australian and New Zealand Map Society (ANZMapS) at Hobart's Museum of Old and New Art (MONA) on 17–18 October 2025.

This two-day conference will examine the ways that cartography has shaped our knowledge of the Southern Hemisphere, from speculative early maps populated with mythical lands to the precision of modern satellite imagery. It also explores how maps have captured, distorted and reimagined some of the world's most remote and extreme southern regions.

Through presentations by leading cartographers and historians, Southern Frontiers will uncover the stories, innovations and enduring misconceptions behind these maps. The conference will offer a fresh look at how mapping continues to influence our understanding of the southern world.

For more info: *anzmaps.org* or contact Dr Catherine Akeroyd via email at *anzmaps1@gmail.com*



Learn how cartographers and artists have portrayed Antarctica through the centuries.

PHOTO CREDITS, FROM TOP: CEDRIC VAN DEN BERG/THE UNIVERSITY OF QUEENSLAND; JOHN WILSON CARMICHAEL/WIKI COMMONS

These little possums likely slipped under the radar in NSW because they're so tiny, weighing a mere 100–160g.

Leadbeater's possum spotted outside Victoria for the first time

When a Leadbeater's possum (*Gymnobelideus leadbeateri*) photobombed a camera trap inside New South Wales' Kosciuszko National Park recently, researchers were left stunned.

The possum was photographed near Yarrangobilly Caves in the park's north by trail cameras installed by the Department of Climate Change, Energy, the Environment and Water to survey smoky mouse (*Pseudomys fumeus*) populations.

Until now, the critically endangered marsupial was thought to be endemic to Victoria and extinct in NSW, known only because of fossils from Yarrangobilly and Wombeyan caves.

It's likely the possum photographed inside Kosciuszko NP is its own unique subspecies.

Introducing the resin pot bee

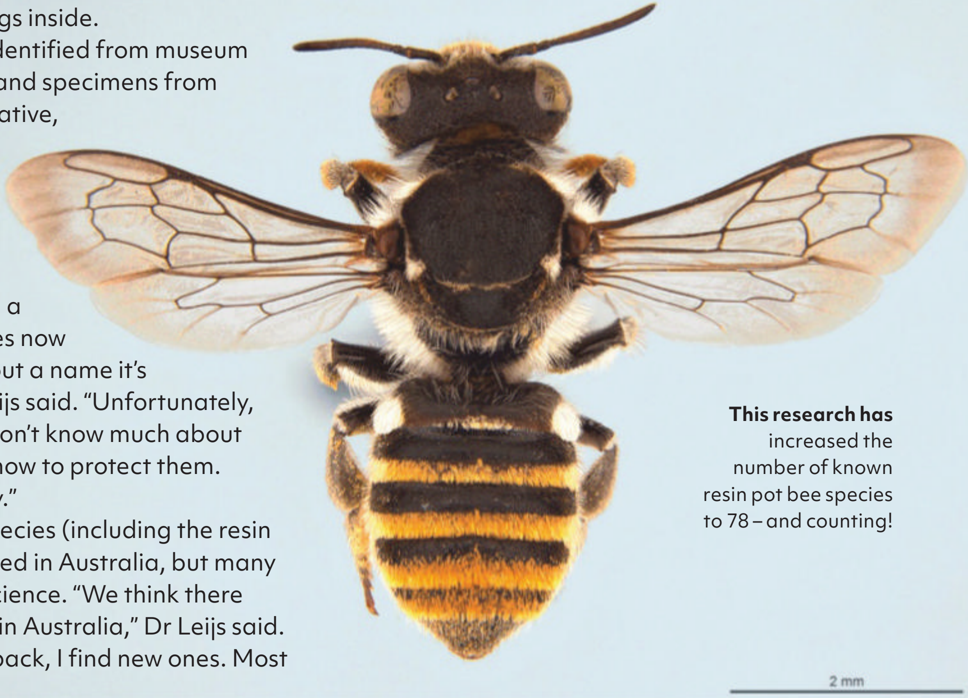
A team of Australian scientists led by Dr Remko Leijs from the South Australian Museum have described 71 new bee species in the subgenus *Austrochile* (genus *Megachile*). The researchers also gave bees in this subgenus a common name – resin pot bees – because they build small 'pots' from tree resin on twigs or branches and lay their eggs inside.

The resin pot bees were identified from museum collections across Australia and specimens from recent field surveys. These native, solitary bees are found in every state and territory except Tasmania. Many species were described from a single bee specimen.

"The important thing with a paper like this is that the bees now have a name, because without a name it's hard to protect them," Dr Leijs said. "Unfortunately, for most of the species, we don't know much about their biology and therefore how to protect them. Some could be gone already."

About 1800 native bee species (including the resin pot bees) have been described in Australia, but many others remain unknown to science. "We think there are more than 2500 species in Australia," Dr Leijs said. "Every time I go into the outback, I find new ones. Most of those are chance meetings though. Next time you go, they may not be there."

The research, published in the *Australian Journal of Taxonomy*, was supported by a Bush Blitz taxonomy grant.



This research has increased the number of known resin pot bee species to 78 – and counting!

PHOTO CREDITS, FROM TOP: ZOOS VICTORIA; REMKO LEIJS

Acidic emissions are weathering the ancient petroglyphs at Murujuga.

Industrial pollution threatens Pilbara site's UNESCO World Heritage listing

The world's largest rock art site, Murujuga, might not meet the requirements to join the UNESCO World Heritage List because it's impacted by acidic emissions generated by local fossil fuel plants.

More than 1 million petroglyphs – rock art engravings – are found at Murujuga in the Pilbara region of north-west Western Australia. The cultural site spans some 100,000ha across the Burrup Peninsula and the 42 islands of the Dampier Archipelago.

Murujuga Cultural Landscape was formally nominated to join the UNESCO World Heritage List in early 2023. But new reports, published by UNESCO's World Heritage Committee and its advisory body, the International Council on Monuments and Sites (ICOMOS), reveal the listing will likely be referred back to Australia.

The ICOMOS report said acidic and nitrate-rich emissions generated by nearby fossil fuel industries – especially the production of liquefied natural gas – may "accelerate weathering of the petroglyphs, impacting their visibility and stability". It concluded that the site "would no longer meet the requirements for World Heritage Status" if acidic emissions continued to degrade the petroglyphs.

The report was published two days before the federal government granted a 40-year extension to Woodside's North West Shelf gas project, also on the Burrup Peninsula, to operate until 2070. It named Woodside's gas plant as "the single most significant source of these acidic industrial emissions".

OZ DIARY

Nationwide

LEARN SOMETHING NEW

Whether you're interested in chemistry, space, Indigenous knowledge, health and medicine, agriculture or palaeontology (or more!), there's something for everyone this National Science Week (9–17 August). This year's program has more than 2000 in-person and online events, including talks, webcasts, DIY experiments and competitions. Don't miss it!

MORE INFO: *scienceweek.net.au*

VIC

CELEBRATE OUR GENTLE GIANTS

The Island Whale Festival, taking place 11–13 July at Phillip Island in southern Victoria, is held each winter during peak whale season. Its program includes whale-watching cruises, whale spotting, art installations, educational talks, arts and crafts, wildlife experiences and more.

MORE INFO: *islandwhales.com.au*

NT

EXPERIENCE YOLNGU CULTURE

Garma Festival, Australia's largest Indigenous gathering, returns 1–4 August 2025 at the Gulkula ceremonial site in north-east Arnhem Land. The festival, hosted by the Yothu Yindi Foundation, features traditional storytelling, bunggul (dance), manikay (song) and miny'tji (art).

MORE INFO: *yyf.com.au/garma-festival*

PHOTO CREDITS, FROM LEFT: NICK RAINS; MELANIE FAITH DOVE

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Wild populations of helmeted honeyeaters have increased from 60 individuals in 2013 to about 250 today.

Return of the helmeted honeyeater

Conservationists from Healesville Sanctuary, Victoria have released 21 helmeted honeyeaters (*Lichenostomus melanops cassidix*) in Cardinia, in the state's south-east, as part of a bid to establish a third wild population of the critically endangered species.

The helmeted honeyeater was wiped out from Cardinia more than 40 years ago in the 1983 Ash Wednesday bushfires. It's one of Australia's rarest birds, with fewer than 250 remaining in the wild. The other two populations are found at Yarra Ranges National Park and Yellingbo Nature Conservation Area.

"This is just the start," said Dr Nick Bradsworth, helmeted honeyeater field officer at Zoos Victoria. "We're just going to keep building from here. Hopefully we can create even more populations throughout eastern Victoria through their former range, so our bird faunal emblem can thrive for years to come."

PLACENAMES

By Kel Richards

WOLLUMBIN / MT WARNING

ON 16 MAY 1770, Captain James Cook was sailing the HMS *Endeavour* along the east coast of Australia. As he approached land, he spotted through his telescope the peak of this 1159m-tall mountain, which stands about 14km from present-day Murwillumbah in northern New South Wales.

That sighting warned him he was getting close to shallower waters, so he gave it a name: Mt Warning.

Two hundred years later, in 1970, the NSW Geographical Names Board gave the landmark a dual name: Wollumbin – which means 'patriarch of the mountains' in the local Bundjalung–Yugambeh dialect.

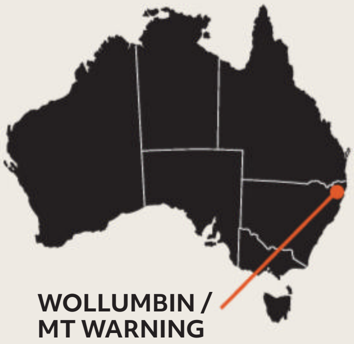

PHOTO CREDIT: ALAMY/JAMES PEAK

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SNAPSHOT

Handback of Uluṟu

Uluṟu-Kata Tjuṯa National Park was returned to its Traditional Owners 40 years ago.

ON 26 OCTOBER 1985 the Aṉangu received the title deeds for Uluṟu-Kata Tjuṯa National Park in a landmark ceremony held at the base of Uluṟu. It marked the end of a lengthy lobbying campaign by Traditional Owners to receive recognition for their land rights. For at least 30,000 years, the Aṉangu – a language group comprising several groups in the Western Desert cultural bloc – have lived in Australia's Red Centre, caring for Country. Achieving legal recognition for their land rights was a fight decades in the making.

After European settlement, the area that's now Uluṟu-Kata Tjuṯa NP was spared from pastoralism because of its unsuitability for agriculture. From 1920 to the 1940s it was an Aboriginal reserve named the South-Western or Petermann Reserve. Its isolation meant few non-Aboriginal people had visited the area, apart from the odd adventurer and mineral prospector. But in 1948 the federal government – recognising the area's tourism potential – built the first dirt road to Uluṟu. Two years later, it gazetted the then-named Ayers Rock National Park, designating it as Crown Land. Tourism boomed.

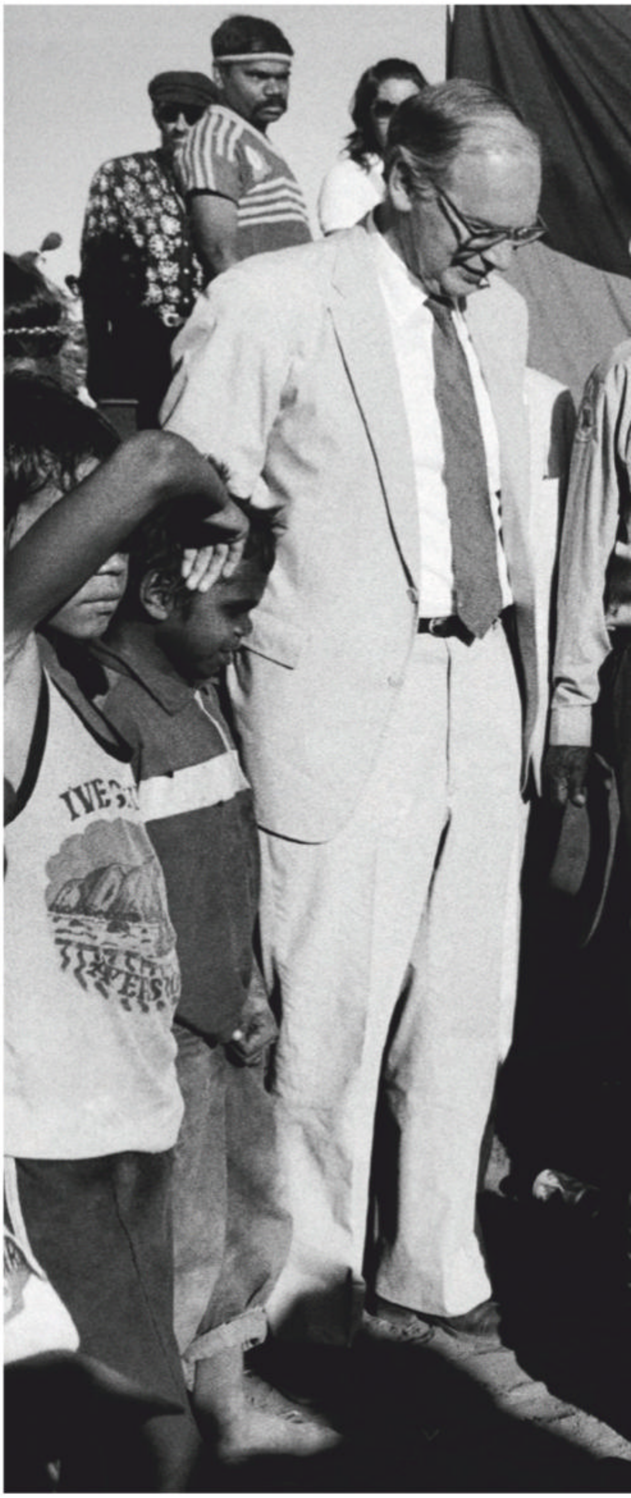
The Aṉangu did not help manage the park in its early years. In fact, many were discouraged from visiting it. Over the next few decades, sacred sites were desecrated and impacted by tourists. Dozens of people died attempting to climb Uluṟu – despite the 'safety chain' installed in 1966 – and their foot traffic eroded parts of the monolith's surface. Visitors nearly trampled local shield shrimps to extinction and left behind rubbish that ended up in waterways.

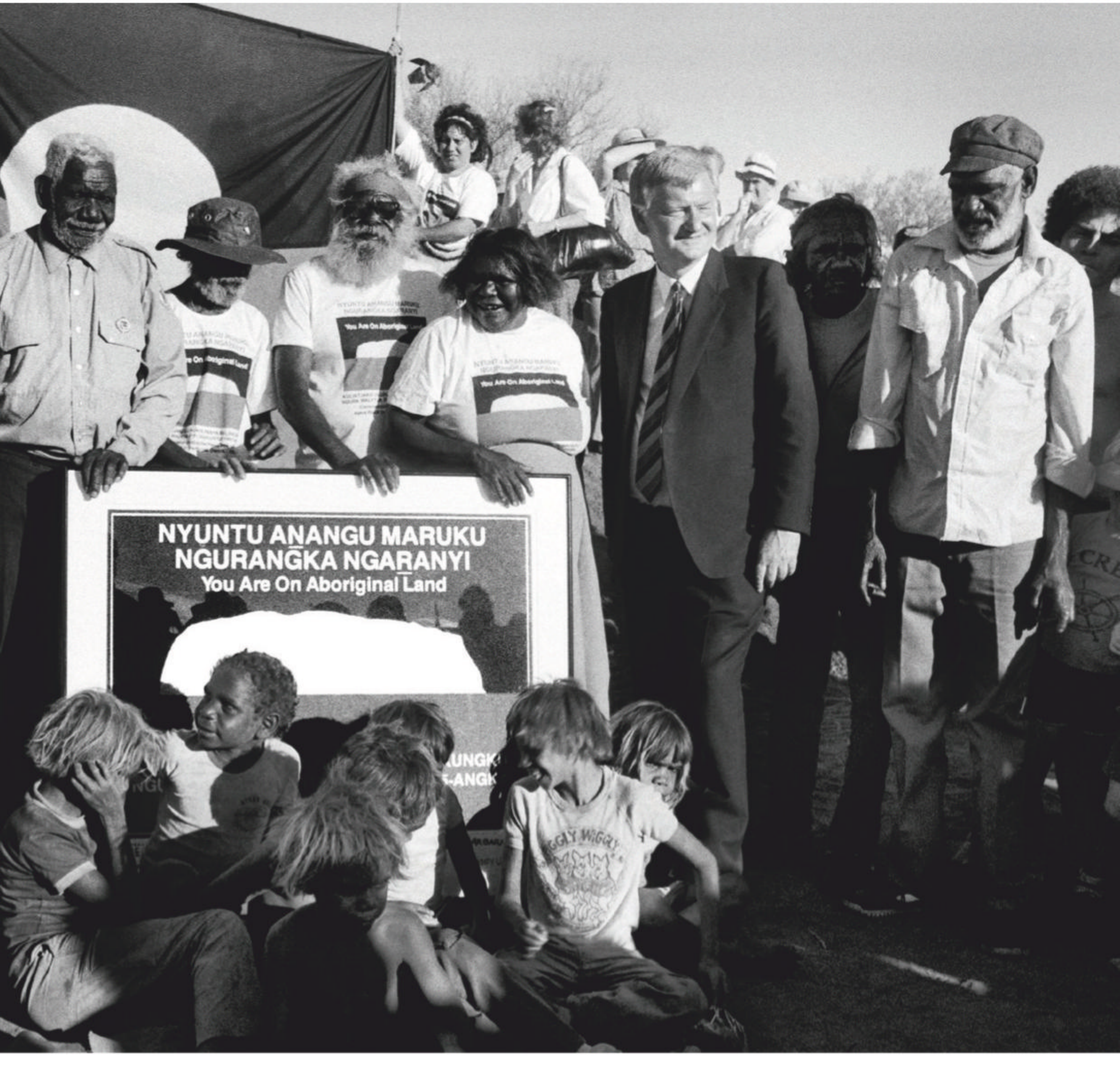
In the 1960s, the Aboriginal land rights movement gained momentum with watershed events such as the Yirrkala bark petitions and Wave Hill Walk-Off, the latter of which would go on to influence the *Aboriginal Land Rights (Northern Territory) Act* in 1976. This landmark legislation recognised First Nations land ownership and allowed mobs to claim land rights if they could prove traditional association.

Uluṟu-Kata Tjuṯa NP's status as Crown Land meant it was ineligible for a land rights claim. Traditional Owners, Pitjantjatjara Council and the Central Land Council began lobbying then-prime minister Malcolm Fraser and his government for the legislation to be amended so they could claim land rights as Traditional Owners. Meanwhile, the NT Government – having achieved self-government in 1978 – wanted the park's title to be transferred into its jurisdiction, and snubbed the lobbyists' efforts.

The deadlock ended in November 1983 when Bob Hawke's newly elected government announced the national park's title would be transferred back to the Aṉangu. At the official handback ceremony, which took place nearly two years later, Traditional Owners signed an agreement to lease the park back to the Australian Parks and Wildlife Service (the disgruntled NT Government chose to withdraw from all management arrangements). A board – chaired by Yami Lester and with a majority of Aṉangu members – was founded to manage the park. The park is still jointly managed by the Aṉangu and Parks Australia.

ESME MATHIS




NYUNTU AN̲ANGU MARUKU
NG̲URANG̲KA NGAR̲ANYI
You Are On Aboriginal Land

An̲angu Traditional Owners Peter Bulla, Peter Kanari, Nipper Winmarti, Barbara Tjirkadu and their families celebrate with Governor-General Sir Ninian Stephen and Labor Minister Barry Cohen at the Uluṟu handback ceremony on 26 October 1985.

Photo credit: Juno Gemes. This image features in Juno's book *Until Justice Comes: Fifty Years of the Movement for Indigenous Rights*

NEED TO KNOW

WITH DR KARL KRUSZELNICKI

Nailing down the facts

SOME PEOPLE SPEND a long time focused on a single topic. But how about a third of a century to find out how fast fingernails grow? (Spoiler alert: the short answer is about a 10th of a millimetre per day.)

Back in 1941, just before the military attack on Pearl Harbor, William Bean, a 32-year-old medical doctor, became curious about fingernail growth and decided to conduct his own long-term study. Initially, Dr Bean measured all the nails on his left hand (he was right-handed), as well as the right thumbnail and both big toenails. But as life got busy during the war years, he narrowed his focus to just his left thumbnail.

Look closely at a fingernail and you'll notice a few distinct parts. Just above the cuticle – the thin layer of dead skin between nail and finger – you'll see the nail plate itself. The nail begins with the pale, crescent-shaped lunule and continues into the pink section that's still attached to the nail bed. Finally, it extends to the free edge, where the nail grows beyond the finger.

And so, on the first day of every month, Dr Bean would use a sharp file to grind a very narrow groove into his nail at the cuticle. He'd then measure how long it took for that groove to reach freedom at the other end of the nail. When he was 32, it took 116 days for the groove to migrate to the end. By the time he was 67, it took 153 days. To look at it another way, the average daily growth of the left thumbnail dropped from 0.123mm a day when he was 32, to just 0.095mm a day when he was 67.

He also tried weighing the cut fingernails, but found this was not an accurate way to measure growth because some 25–60 per cent of the nail wears away due to "unnoticed attrition". And he recorded that his individual nails grew at different rates, with the big toenails being markedly slower than his thumbnails.

In his studies of other people, he found those with the chronic skin condition psoriasis had nails that grew faster than those without it. Nail growth also increased by about 25 per cent in pregnant women. They grew faster in children than in adults, and they grew faster in warm climates.

Surprisingly, biting fingernails increased growth rate by about 20 per cent. But strokes, starvation, lactation, anticancer drugs and severe infections caused a "conspicuous slowdown in growth rate". He also touched on the myth that hair and nails continue to grow after death, concluding they did not. Instead, "the processes of protein coagulation and surface desiccation following death, and changes in cutaneous hydration, cause a distinct shrinking of the skin". In other words, the fingernails and hair stay where they are, but the dehydrated flesh shrinks away from them.

Finally, as an afterthought, he suggested a new unit of length: the Nail-Second. It's the distance his "nail grows in one second, which worked out to almost exactly 10 billionths of a metre each second". Not practical for much, but fitting for a man who filed his thumb every month for 35 years.

DR KARL is a prolific broadcaster, author and Julius Sumner Miller fellow in the School of Physics at The University of Sydney. His latest books are *Dr Karl's Little Book of Climate Change Science* and *A Periodic Tale: My Sciencey Memoir*, published by HarperCollins Publishers Australia. Follow him on X @DoctorKarl and TikTok @DrKarl. **More info:** *drkarl.com*

PHOTO CREDIT: ALAMY

OZ WORDS

By Kel Richards

GOT A QUESTION ABOUT AUSSIE ENGLISH?
Contact Kel at:
ozwords.com.au

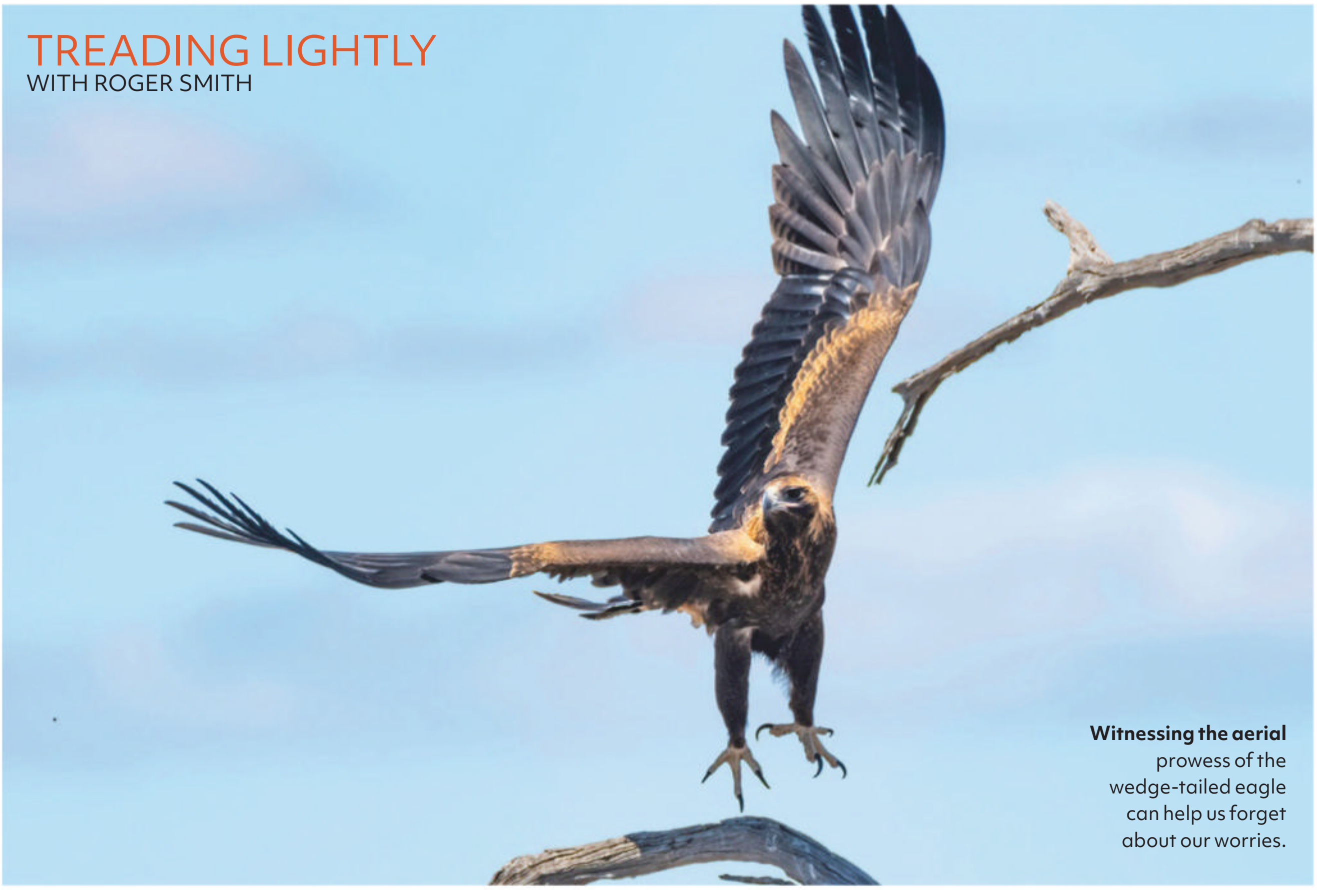
CORFLUTE

WE'VE JUST HAD a federal election during which fences, windows, brick walls and front yards were packed with 'corflutes'. These are, according to the *Macquarie Dictionary*, waterproof plastic signs "used by people running for election". The term is uniquely Aussie. Nowhere else in the world are election signs called corflutes. (They're probably just called annoying!)

'Corflute' originated in 1970 as a registered trademark of the Corex Plastics company of Melbourne. It has since become a general word, without an upper-case 'C'. Walk into any campaign office during an Aussie election and they'll be talking about corflutes. This is one of those trademarks that became a generic name – the same thing that happened to aspirin, hoover, biro, linoleum and countless others.

But unlike those, this one is ours. Presumably, Corex didn't object because it promotes its product. And it's a clever invention: two flat sheets with a corrugated, or 'fluted', sheet in between to keep them rigid. Aussie inventiveness again!

TREADING LIGHTLY
WITH ROGER SMITH



Witnessing the aerial prowess of the wedge-tailed eagle can help us forget about our worries.

Let your spirit soar

The glorious spectacle of nature has the power to lift us up when we need it most.

NATURE REVIVES MY spirits when I'm feeling down. Think of watching an eagle soar upwards until it disappears into the blue, leaving the worries of the world behind.

Like so many humans, I'm envious of the ability of birds to fly. As a child I emulated eagles by making model airplanes. Gliders were my favourite because they flew at the whim of the wind, which worked for my contrarian nature. I once spent weeks making a glider only to lose it in a thermal – it just kept going up into the sky and I never saw it again. I felt no regret. That was my highest aeronautical achievement, to make something that flew so well it simply disappeared up into the vast beyond, like an eagle.

A pair of wedge-tailed eagles live in the hills behind our house. After a successful breeding year, we often see the adults and two youngsters slope-soaring in the wind rising up into the hills. While the adults hang motionless in the updraft, the youngsters mock-attack each other and their parents – our own private wildlife movie on many windy days!

During a recent morning walk on a country road near our place, I saw the two adult eagles perched in an old red gum waiting for a field of barley stubble beneath to heat up and generate warm air currents to provide them with lift. It ultimately occurred with my arrival, after which both birds took off, climbing rapidly on hot air generated within the stubble. With tail feathers splayed and wings thrust forward, they spiralled upwards in a thermal, the smaller male leading with the much larger female tracking him.

After about five minutes, at considerable height, the male left the thermal, powering off at high speed: eagles can travel deceptively fast in a flat glide, covering long distances without a wingbeat. As he neared the hills, he began a series of spectacular stall dives. From each shallow dive he rose steeply, stalled, folded his wings and plummeted 60m vertically before rising straight up, stalling and dropping again. He did this daunting manoeuvre over and over, folding his wings in and out but never flapping.

Watching, I became a boy again, wanting to be him! He was showing off to his mate, who was near me at first but instantly went to join him. Ornithologists call this "pair bonding", but I prefer to think of it as aerial lovemaking. What could be more exhilarating, more romantic, than leaving the earth behind with your lover?

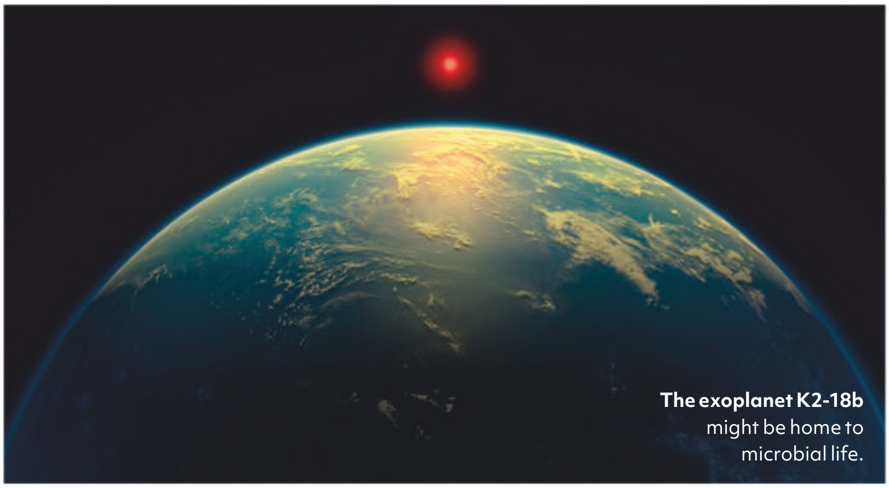
This all sounds like perfection, and it is. But it needs to be paid back. We have a duty to care for nature – for the solace given by eagles – for without nature we are nothing.

ROGER SMITH has a long background in nature conservation, citizen science, wildlife tourism and energy-efficient housing. Now, as Director of Conservation Travel at Australian Geographic Travel, his role is to oversee citizen science activities, implement a climate-action plan and help expand the Conservation Travel portfolio.

PHOTO CREDIT: ALAMY

SPACE

Aliens or chemistry?



The exoplanet K2-18b might be home to microbial life.

ILLUSTRATION CREDIT: A. SMITH/N. MADHUSUDHAN, UNIVERSITY OF CAMBRIDGE

ONE OF THE most profound questions we can ask is whether there are living organisms elsewhere in the universe. So far, there's no firm evidence of life originating anywhere beyond the confines of our world. In trying to answer the question, astronomers look for biomarkers – attributes of an extraterrestrial environment that can only have originated in the presence of life. And it doesn't have to be intelligent life; even humble microbes modify their environment in a manner that could be detected by scientific instruments, whether they be laser zappers on a Mars rover or infrared spectrometers on a giant telescope.

It's the second of these that has made headlines in recent months. Of the almost 6000 exoplanets now known beyond our solar system, only a handful qualify as habitable worlds, where water can remain liquid rather than boiling away or freezing solid. Water is the working fluid of all life on Earth, so finding it in liquid form is a good starting point in the quest for exolife. And one of these habitable planets – known as K2-18b – has attracted considerable attention with reports of intriguing molecules in its atmosphere.

Like many other exoplanets, K2-18b crosses the line of sight to Earth as it orbits its parent star, passing in front of it from our perspective. The planet's atmosphere imprints a spectrum signature of its component gases on the starlight filtering through it. This has now been analysed with the James Webb Space Telescope and, in observations reported last April, UK and US astronomers announced the detection of dimethyl sulphide (DMS) and dimethyl disulphide (DMDS) in K2-18b's atmosphere. On Earth, these gases only occur as a result of biological activity by microorganisms, which makes them biomarkers.

These are tantalising results, but there are good reasons for caution. Even with such a capable instrument as the Webb (currently the best available for this kind of work), they are challenging observations to make. Discoveries are couched in terms of their confidence level, which in this case is somewhat less than the gold standard of certainty. It's possible future observations will rule out the existence of DMS and DMDS altogether. More fundamentally, the biological origin of these gases on Earth doesn't necessarily eliminate a purely chemical formation elsewhere. They may turn out not to be biomarkers, and scientists are now looking carefully at what other kinds of reactions might generate these molecules.

FRED WATSON is an honorary professor at Macquarie University and was Australia's first Astronomer-at-Large. You can find him on ABC Radio, the weekly Space Nuts podcast and on X @StargazerFred.

Looking up by Glenn Dawes

The bulk of the Milky Way galaxy consists of a flattened disc, with a diameter of about 100,000 light-years. Earth is about halfway out from the centre, embedded in the Orion spiral arm. Most stars visible from suburbia are relatively close by, out to about 500 light-years away. However, exceptions are always interesting, and here's a real contrast: the closest, Alpha Centauri (4.4 light-years away), is one of the brightest stars. Its main components have a similar luminosity to the Sun. The star Deneb (Alpha Cygni) is still respectable, being the 20th brightest star, but it's about 1700 light-years distant! Deneb is one of the largest and most luminous stars known in our galaxy, outshining the Sun by 50,000 times – a real behemoth.

Full Moon
Friday
11 July

New Moon
Friday
25 July

Full Moon
Saturday
9 August

New Moon
Saturday
23 August

8–17 AUGUST 2025

Dawn spectacle!

Meetings (conjunctions) between the two brightest planets, Venus and Jupiter, are impressive. July and August finds Jupiter rising out of the eastern dawn glow into the morning. During this time, Venus (the considerably brighter of the two) is dropping towards the Sun, also in the morning. Mid-July finds Venus around 30° to the upper left of Jupiter. The gap closes, and they finally pass each other, making their closest approach of 1° (twice the diameter of the Moon) on 13 August. The planets are within 5° of each other from 8–17 August, making for nice naked-eye and binocular views alike.

GLENN DAWES is a co-author of the yearbook *Astronomy 2025 Australia* (Quasar Publishing), which can be purchased from Australian Geographic. **See:** *australiangeographic.com.au*

DEFINING MOMENTS
IN AUSTRALIAN HISTORY

The wheat that changed Australia

1903

William Farrer begins distributing Federation wheat

WHEAT WAS ONE of the first crops planted by colonists in Australia, in 1788. Although initial harvests were poor, the grain soon became Australia's most important crop. But harvests began to decline in the second half of the 19th century due to the devastating wheat disease known as black stem rust. Late in the century, English agronomist and plant breeder William Farrer experimented with crossbreeding wheat to produce the first specifically Australian variety that was both rust- and drought-resistant. He called it Federation wheat.

"In a new country like this," Farrer wrote, "where the climate is so widely different… the traditional practices of the old country have to be unlearnt, in addition to entirely new ones learnt."

Australia's first wheat was sown in Sydney soon after the First Fleet arrived. Colonists had brought different grain varieties, and a small 9-acre farm was established at Farm Cove on the site of the current Royal Botanic Garden to raise and experiment with various crops. The climate, soils and seasons were so unlike those of the wheat's native land that early harvests were very poor.

Convict James Ruse was one of the few experienced farmers on the First Fleet. In July 1789 he claimed he'd served his seven-year sentence and asked Governor Arthur Phillip for his freedom and a land grant. Ruse was allowed to farm a smallholding near Parramatta and, with productive harvests over the next two years, proved wheat could be a successful crop in the new colony. Phillip granted him title to the land, making Ruse the first freed convict to receive title to land in New South Wales.

As new agricultural areas opened across Australia, wheat became our primary crop and eventually an export commodity. Shipments to England began in 1845, and by 1870 exports were regular. But from 1840 to 1860 stem rust forced farmers to move farther inland to drier, hotter conditions that were less suitable for European-derived wheats. Grain productivity gradually decreased. In 1889 a severe rust epidemic cost the wheat industry up to £3 million (more than $500 million today) in lost production, and grain millers in the colonies had to import wheat. Colonial governments recognised the need for coordinated action, and from 1890 held annual, national conferences to address how best to fight the disease.

William Farrer was the 'father' of Australia's wheat industry.

William Farrer, born in 1845 in Westmorland, northern England, received a scholarship to Cambridge University and gained a Bachelor of Arts in 1868. He began studying medicine but was unable to finish the degree after contracting tuberculosis. At 25 he migrated to Australia hoping the climate would benefit his health. He began working as a tutor at George Campbell's sheep station, Duntroon, in what is now Canberra. He soon developed an interest in agricultural science, and his focus turned to issues of wheat-growing in Australia. Farrer came to believe farmers' difficulties were rooted in the unsuitability of European-derived wheats to the Australian climate. He had hoped to buy pastoral land but, lacking funds, instead qualified as a surveyor and in 1875 began work for the NSW Department of Lands.

In the early 1880s Farrer began selecting seed from superior wheat specimens around the colonies and planted them in small, carefully delineated plots on his father-in-law's property at Cuppacumbalong, NSW, also near present-day Canberra. He was aiming to find the most suitable species for the Australian climate and soon extended his experiments to include overseas varieties. In 1886 Farrer bought nearby Lambrigg Station and, in some of the world's first plant hybridisation experiments, began crossbreeding the different wheats he'd identified. Disastrous wheat crops in 1889 and 1890 brought Farrer's work to the fore, and he made visits to wheat-rust conferences around the country to discuss his findings. Unlike his contemporaries, Farrer sought to produce a wheat that was not only rust-resistant but also better for milling and baking.

In 1898, he was appointed as a wheat experimentalist with the NSW Department of Agriculture and worked with government chemist F.B. Guthrie, who made miniature flour mills and bakehouses available to him. Farrer could now mill and bake small quantities of many types of hybrid grain and select the strongest, based on evidence. He came to believe that Indian wheat, which escaped rust because of its early maturity, could be the basis for a more disease-resistant plant. Meanwhile, Farrer and Guthrie confirmed that Canadian Fife wheat was unmatched in milling performance but vulnerable to rust due to its late-season maturity. The answer seemed to lie in hybridising the two, resulting in new strains such as Yandilla and Comeback.

Farmers began to adopt Farrer's new wheats, but the key breakthrough came when he combined Yandilla with the high-producing, European-derived Purple Straw variety to create a rust-resistant, high-yielding, strong-stemmed plant. Farrer named it 'Federation' in honour of the union of Australia's colonies in 1901. Distribution of Federation wheat began in 1903, and the wheat industry quickly recognised its potential to transform Australian agriculture. Thanks largely to Farrer's vision and efforts, wheat remains Australia's most valuable crop today.

national museum australia

Part of the Defining Moments in Australian History project
TO FIND OUT MORE: nma.gov.au/defining-moments

PHOTO CREDIT: ALAMY

TIM THE
YOWIE MAN

Busting bat myths

The claim that bats only fly left when exiting a cave is a common misconception.

MANY YEARS AGO, when I was in school, I had to complete an assignment on bats. Among the various 'facts' I found in some obscure reference book was that 'bats fly left when leaving a cave'.

Somehow, I jagged an A. In retrospect, my science teacher, Mr Brown, ought to have failed me because – in today's parlance – it was fake news.

"It's a complete myth," says Terry Reardon, life member of the Australasian Bat Society. And Terry should know – he's been studying bats for more than half a century. "Which way bats leave a cave depends on a number of factors, including the topography around the cave and the direction of food and water sources," he says.

Terry has spent the past four years closely observing southern bent-wing bats at Naracoorte Caves in South Australia. "They just fly out in different directions, some north, some south, and at no particular angle," he says. "My observations at cave and mine entrances suggest no universal exit direction."

And before you ask: no, the bats don't return to the cave from a certain direction. "They come in from every direction," Terry says. He often observes them returning at dawn from the comfort of his swag.

So, what about other caves?

NSW National Parks and Wildlife Service ecologist Doug Mills has been studying eastern bent-wing bats at Wee Jasper for almost 20 years. He admits he gets asked the question often, but says "there's no scientific basis to the claim they turn left".

"On their nightly forages for food and water the bats usually exit to one side of the cave, but that's because it's just easier for them to exit on that side as it means they can fly downhill. If they were to turn the other way, it'd be a bit harder for them to get the elevation they need to fly off," he says.

It begs the question: do left and right actually have meanings in a cave context?

"For caves that have vertical entrances, the direction of flight is dependent on where the viewer is," Terry says. "Only for caves with horizontal entrances do left and right have meaning."

An equally intriguing conundrum is which direction bats circle while preparing to exit a cave.

At Naracoorte Caves, Terry has recorded southern bent-wing bats circling en masse in a clockwise direction before embarking on their nightly flyout from a maternity cave.

"After the bats circle below the entrance, they fly out of the cave and disperse in multiple directions," Terry says. "We don't have cameras in other caves, so we aren't sure if this is just in this cave or if it's a more general habit."

What it does show is how much more we still have to learn about these fascinating creatures. One thing is for sure, though: the myth that bats fly 'left' out of a cave is most definitely busted.

Sorry, Mr Brown.

TIM, a naturalist, author, broadcaster and tour guide, has dedicated more than 30 years to documenting unusual natural phenomena in Australia. His books include *Haunted and Mysterious Australia* (New Holland, 2018). Follow him on Facebook and X @TimYowie

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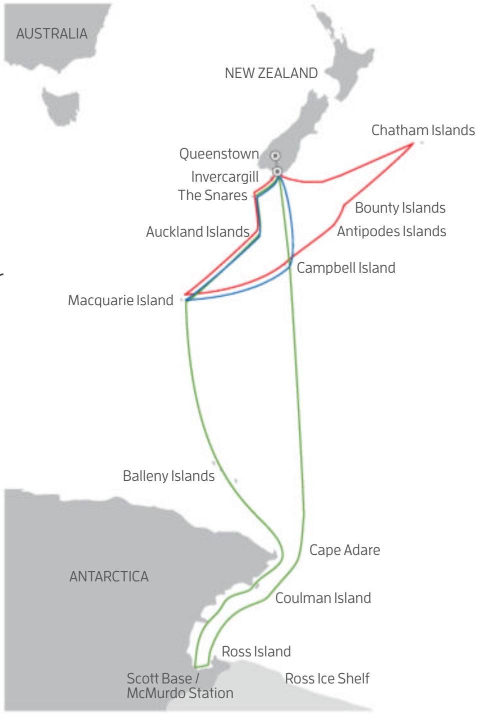

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EARTH VIEW
PERSPECTIVE

Crystalvale Nature Refuge in Cape York is a property that's combining cattle grazing with carbon farming and wildlife conservation.

Private landholders key to conservation

Carbon and biodiversity markets will help unlock the potential of privately owned properties.

AUSTRALIA'S COMMITMENT TO the 30x30 target – a strategy that aims, as part of a global obligation, to protect 30 per cent of the country's landmass by 2030 – is ambitious, and we remain far from achieving it. An additional 60 million hectares must be added to the national conservation estate within the next five years to meet this goal.

Encouragingly, progress is underway with initiatives such as the Private Protected Areas (PPA) program developed by the Queensland Government. To accelerate efforts, we must prioritise the reinstatement of the Nature Positive Plan – the federal government's reform strategy for laws and policies aimed at protecting the environment – and further incentivise the conservation of private land.

Private landholders manage about 60 per cent of Australia's landmass, making them essential allies in achieving national conservation goals such as the 30x30 target. By entering into PPA agreements, landholders can protect biodiversity while continuing to engage in sustainable and profitable economic activities.

PPAs are designed to allow compatible activities such as sustainable cattle grazing, carbon sequestration projects under the Australian Carbon Credit Unit (ACCU) Scheme, and ecotourism to coexist with biodiversity protection.

Nature refuges, a key covenant option available through Queensland's PPA program, offer a mechanism to conserve both natural and cultural heritage while enabling landholders to continue sustainable economic activities.

Queensland's NatureAssist fund supports landholders to establish nature refuges. In Cape York, the newly declared Crystalvale Nature Refuge is a leading example of how conservation can be successfully combined with cattle grazing and carbon farming. It demonstrates how PPAs can enhance biodiversity and cultural heritage while maintaining economic viability.

The growing maturity of the carbon market has played a pivotal role in increasing the viability of PPAs. While early examples, such as the Henbury Station carbon farming project in the Northern Territory, faced setbacks due to the absence of a suitable carbon method, today's more developed carbon market allows for consistent returns from nature-based emissions reduction and sequestration projects.

The recent Queensland Land Court decision against Waratah Coal's proposed mine on the Bimblebox Nature Refuge in central Queensland also provides growing legal support for nature refuges, boosting landholder confidence in their long-term value.

To meet the 30x30 target, we need clear guidance around PPA eligibility and participation in the Nature Repair Market. While the federal government has committed to developing a permanent protection method, interim steps such as recognising Other Effective area-based Conservation Measures (OECMs) may help – although these lack the same legal strength as PPAs.

With 4.9 million hectares already protected in Queensland – 45 per cent of Australia's PPA network – future progress will require strong policy support and sustained investment, particularly for programs such as NatureAssist and the ACCU scheme.

Empowering landholders through carbon and biodiversity markets is key to achieving Australia's conservation goals.

DR KATE DODDS, Chief Technical Officer, Corporate Carbon Group, is an ecologist who has worked extensively in marine and terrestrial environmental consulting in Southern Africa and on Blue Carbon co-benefits and financing mechanisms in Australia.

PHOTO CREDIT: GROW LOVE MEDIA

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Q & A SCREENING LARAPINTA: END TO END

An Australian Geographic Awards Roadshow event in partnership with Coral Expeditions.

Larapinta: End to End is a film about the highs and lows of a team of Tasmanians, all with disabilities, as they traverse some of the harshest terrain in Australia during 17 days in 2022. Enjoy the film and join team leader, Paul Pritchard, for a Q & A discussion about the dignity of risk.

Wednesday 23 July 2025, 6.30–9pm
Library Auditorium, State Library of NSW,
Macquarie Street, Sydney NSW 2000

Tickets from $15–$35. School students free.

Pre-booking required.
Scan the QR code to book your tickets.

Citizen scientists search for elusive platypuses in waterways near Melbourne.

PEOPLE POWER

ORGANISATIONS AND PROJECTS that encourage or even rely on citizen science to help achieve their aims figured highly among the 2024 Awards for Nature recipients. Innovations such as smartphones and artificial intelligence enable everyday people – keen to be part of the solution – to mobilise for the defence of nature.

We've been thrilled to hear from our 2024 award recipients about how the Society's funds helped expand their programs and grow their impact. See page 29 for a project report from the Australian Marine Debris Initiative (AMDI), our silver-tier winner.

With a creature as mysterious and elusive as the platypus, it's critical to recruit as many eyes and ears as possible to be able to monitor populations effectively. Each spring, the platy-project enlists the help of citizen scientists up and down the east coast to monitor local waterways in search of platypuses, or evidence of their presence. This Australian Conservation Foundation (ACF) initiative – in partnership with the University of New South Wales, which pioneered the platy-project map – was created to address critical knowledge gaps in platypus data.

Visit ACF's website (see link below) to sign up for a platypus survey this September and October. Platypuses are known to inhabit city rivers, creeks, farm dams and reservoirs. They may be closer than you think, so no matter where you live on the south-east coast, you can play a part in securing their future.

For more info: *acf.org.au/get-involved/the-platy-project/platy-project-signup*

CHRISSIE GOLDRICK
Chair, Australian Geographic Society
cgoldrick@australiangeographic.com

SAVE THE DATE

The **Australian Geographic Awards for Nature** presentation will take place at the Australian Museum in Sydney on Thursday 23 October 2025 at 6.30pm. It will also be the opening night of the Australian Geographic Nature Photographer of the Year exhibition. The five winners will share a total of $150,000 in nature funding. If you would like to know when tickets go on sale, please email the society on *society@ausgeo.com.au* and register your interest.

PHOTO CREDIT: COURTESY AUSTRALIAN CONSERVATION FOUNDATION

AUSTRALIAN GEOGRAPHIC AWARDS FOR NATURE

Progress Report: AMDI Monitoring Network

Since December, four new community groups have joined the Australian Marine Debris Initiative (AMDI) Monitoring Network. All groups directed the Society's funding toward having a Tangaroa Blue Foundation (TBF) staff member support them through their first litter and marine debris monitoring sessions. This helped build confidence, ensured quality data and established a strong foundation for independent monitoring going forward.

On Victoria's Phillip Island, 10 volunteers attended a workshop co-hosted by Phillip Island Nature Parks and Visit Phillip Island. Two new monitoring sites – Anzacs Beach and Kitty Miller Bay – are now up and running. Citizen scientists are conducting monthly marine debris surveys here.

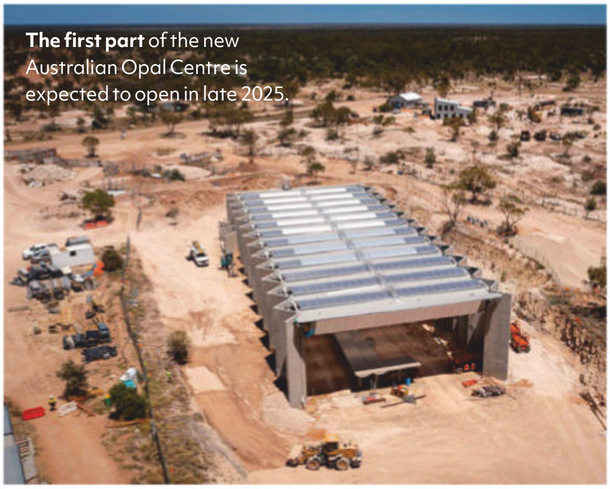
In Lakes Entrance, also in Victoria, 11 locals attended a workshop in March at the Slipway Sheds, followed by a planning session to determine priority sites. The first monitoring event is underway with TBF support.

Ten community members attended a workshop in Hastings, Victoria, hosted in partnership with the Western Port Biosphere and Port of Hastings.

Thirteen volunteers from South Australia's Eyre Peninsula have completed a full day of training, following discussions with Lower Eyre Coastcare Association, eyrelab and the Eyre Peninsula Landscape Board, leading to the establishment of a quarterly monitoring site at Bolingbroke Beach.

And in Tassie, conversations are underway with Adrift Lab, a research group focused on seabirds and marine plastics, for a new site launch in late 2025.

Volunteers on the Eyre Peninsula receive hands-on training from TBF staff.



The first part of the new Australian Opal Centre is expected to open in late 2025.

OPAL CENTRE UNDERWAY

The long-awaited Australian Opal Centre (AOC) is under construction on Yuwaalaraay country at Lightning Ridge in north-western NSW. The facility will be the world's leading not-for-profit centre dedicated to the science, art, industry, people and culture of opals, Australia's national gemstone. It will house permanent and temporary exhibitions, support scientific research and creative collaborations, and offer educational, training and cultural programs. It will tell stories about Australia's opal fields and introduce visitors to opalised fossils – the most beautiful and valuable fossils in the world, 100 million years in the making.

Over many years, Australian Geographic readers have enthusiastically participated in fossil digs in Lightning Ridge that have raised significant funds for the Society. Their efforts have helped make the Opal Centre a true people's project.

We're currently exploring new visitor opportunities for when the amazing new centre is finished. In the meantime, there are still a few places left on the fossil digs that take place during August. If you'd like to join, please visit *australianopalcentre.com/fossil-digs*

FUNDRAISING CAMPAIGN

The January–February campaign to raise funds for the bridled nailtail wallaby brought to a close a year of fundraising in partnership with Australian Wildlife Conservancy. We began the partnership in 2024 with a greater bilby campaign that included temporary bilby tattoos sold by our retail partner, QBD Books. Throughout the year we turned the spotlight to other at-risk species – including the numbat, chuditch, Gouldian finch (pictured), northern hairy-nosed wombat and bridled nailtail wallaby – that AWC is fighting to save. In total, we contributed $80,384.43 to the AWC thanks to our readers' generosity.

Meanwhile, the second species in our partnership with Bush Heritage is the adorable red-tailed phascogale. Find out more about this little-known member of the Dasyurid family – and about Bush Heritage's work with wild populations in WA's Wheatbelt – on page 32, as well as how you can donate.

PHOTO CREDITS, CLOCKWISE FROM TOP: COURTESY AUSTRALIAN OPAL CENTRE; SHUTTERSTOCK; COURTESY TANGAROA BLUE FOUNDATION

Science communicator Catherine Nielsen travelled to Antarctica as part of Homeward Bound's STEMM women in leadership program.

ADVENTURE NEWS

From April to October 2024, **Joash 'Seggy' Taufa'ahau** crisscrossed Tasmania entirely on foot. For Seggy, the 1300km journey was more than a test of physical endurance – it was a deep exploration of Tasmania's raw, untamed landscapes and the generous spirit of its people.

For nearly six months, he connected Tasmania's geographical extremes – east, north, west and south – and crossed into its true geographical centre. Covering 30–50km per day, Seggy visited Woolnorth Point in the north-west, Eddystone Point in the east and Recherche Bay in the south. He also stood at the Edge of the World lookout on the Arthur River in Takayna and headed inland to Bronte Park in Tasmania's centre.

"My total time in Tasmania taught me many things but, above all, reinforced the proverb: 'If you want to go fast, go alone. If you want to go far, go together,'" Seggy says. "Though this expedition was a solo project, it was far from a solitary journey. I'm deeply grateful to the 'many hands' of Tasmanians who helped carry me over the finish line with kind hearts and a spirit of generosity; it made all the difference."

Joash 'Seggy' Taufa'ahau hiked across Tasmania on foot in 2024. He's pictured here in Rocky Cape National Park, in the state's north-west.

Science communicator **Catherine Nielsen** has ventured even further south, to Antarctica. "With the support of Australian Geographic, and as part of the Homeward Bound leadership initiative, I was able to learn, see and experience more from the Antarctic environment, and from the incredible group of 124 women with me, than I ever thought possible," Catherine says.

The group was part of a program aimed at heightening the influence and impact of women and non-binary people in making decisions that shape our world.

They spent 15 days on the Antarctic Peninsula, venturing south to the Lemaire Channel, setting foot on the continent at Orne Harbour, landing at various islands and using inflatable rafts to view areas inaccessible by foot.

They heard firsthand from researchers who experience and record changes to the planet at Palmer Station and Port Lockroy. They also engaged in seminars designed to develop leadership skills and build connections.

Catherine enjoyed unforgettable natural sights, sounds and smells – provided by huge penguin rookeries – and had some extraordinary iceberg encounters. But it was hard to avoid the reality of the effects of climate change.

"As a science communicator, I can't just tell the stories that bring joy; I have to tell the stories that help people understand, help people care," she says. "This is the reason we were there. To bear witness to all that is happening and understand our place and our impact. These are such strong and passionate individuals, and when you are surrounded by such strength you cannot help but be inspired. These women are going to change the world. Maybe not for everyone, and maybe not on the scale they wish, but their infectious attitude will change those around them, and their legacy will far outlive them."

PHOTO CREDITS, FROM TOP: CATRIONA VI NGUYEN-ROBERTSON; COURTESY JOASH TAUFA'AHAU

EVENTS

Australian Geographic Awards Roadshow with Paul Pritchard

Q & A screening of *Larapinta: End to End*

with Paul Pritchard

Hosted by Chrissie Goldrick,
chair of the Australian
Geographic Society

Learn about the inspiring life of Paul Pritchard in this Q & A.

Despite catastrophic injuries sustained during an ascent of the Totem Pole in Tasmania in 1998, the Society's 2018 Spirit of Adventure winner Paul Pritchard has continued to lead a life filled with adventure as a climber, caver, cyclist and kayaker. Paul suffers from hemiplegia, but still leads expeditions that enable fellow adventurers with disabilities opportunities to achieve record-breaking feats of endurance.

In 2022 he walked the Larapinta Trail in the Northern Territory with three fellow adventurers with medical and mobility challenges. That expedition has been turned into *Larapinta: End to End*, a heartwarming film about overcoming the odds and finding courage – with plenty of humour. Don't miss the opportunity to see this inspiring documentary and hear from Paul, a gifted speaker. All proceeds go to the Australian Geographic Society.

Where: Library Auditorium, State Library of New South Wales, Macquarie Street, Sydney NSW 2000

When: Wednesday 23 July 2025 at 6.30pm

Tickets: $35 for general admission.
$30 for Australian Geographic subscribers.
$15 for pension card holders and full-time students under 30.
School students are free, but must hold a valid ticket booked in advance.
Scan the QR code to book your tickets.

Coral Futures Expedition

The Society is joining forces with Forever Reef and Coral Expeditions to offer a very special travel opportunity on the Great Barrier Reef in December this year.

The seven-night voyage, departing on 4 December 2025, will be hosted by Dr Dean Miller and feature other expert guides. The expedition will contribute to reef conservation initiatives such as the Forever Reef Project, and to the Society's Awards for Nature program. Don't miss this unique opportunity to travel with purpose, combining adventure with science to safeguard the future of our greatest natural asset. Prices start from $8650. For more information, see page 116.

PHOTO CREDIT: COURTESY PAUL PRITCHARD

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SAVING A TINY POWERHOUSE

STORY BY **CHRISSIE GOLDRICK**

Deep in the fragmented landscapes of Western Australia's agricultural heartland, a little Aussie battler is holding on against the odds.

Red-tailed phascogales are nocturnal marsupials that nest in tree hollows.

RED-TAILED PHASCOGALES MAY not be as well-known as their Tassie devil cousins, but these feisty little marsupials deserve their moment in the spotlight.

Despite their diminutive size (weighing just 40–60g), these mostly arboreal creatures can leap distances of up to 2m between trees. They're fast and agile hunters with a voracious appetite for insects and spiders (and the occasional unattended chick in a nest). They rarely drink water, but they do extract moisture from the food they eat. And males expend so much energy during the mating season that they perish as soon as the job's done. Known as semelparity or suicidal mating, it's the ultimate sacrifice for the good of the species, leaving females with less competition for food and shelter as they raise young.

But even with these remarkable behaviours and adaptations, red-tailed phascogales are no better equipped to deal with the deadly cocktail of biodiversity threats – habitat loss, ferals, climate change and altered fire regimes – than any other Australian native creatures of similar size.

Dr Genevieve Hayes is an ecologist with Bush Heritage Australia who is working to protect threatened species across Western Australia's south-west. One of her key projects involves the red-tailed phascogale, which once inhabited vast swathes of arid and semi-arid Australia but today survives in just 1 per cent its former range. One such refuge is Kojonup Reserve, on Goreng Noongar Country about 260km south-east of Perth.

"Kojonup was Bush Heritage's first property in WA," Genevieve says. "It's a small reserve at just less than 390ha in the Wheatbelt. In this highly cleared landscape, there's less than 10 per cent of remnant bush left, and less than 1 per cent is preserved in conservation estates."

The reserve protects a critically endangered ecological community known as the Eucalypt Woodlands of the Western Australian Wheatbelt. Wandoo trees (*Eucalyptus wandoo*), endemic to south-western WA and culturally significant to Noongar people, were heavily logged for their hardwood after European settlement, and large stands such as those inside Kojonup are rare. These long-lived trees have deep nesting hollows that provide shelter for many species, including the red-tailed phascogale – but competition for these hollows can be fierce.

Kojonup was well-managed prime phascogale habitat when the WA government began looking for reintroduction sites for the species in the early 2000s. "They reached out to our former ecologist, Angela Sanders, and suggested that Kojonup would be a great site for a translocation. They sourced animals from four nature reserves nearby," Genevieve says.

The first translocation took place in 2010, with 20 individuals released into purpose-built artificial nest boxes in the northern part of the reserve. When post-release monitoring showed low recapture rates, another 10 animals were released the following year into the western part of the reserve. The boxes, placed about 2m off the ground in trees, were designed to provide shelter and encourage site fidelity, discouraging the animals from dispersing too widely in search of suitable habitat. The boxes were lined with soft materials such as alpaca or sheep wool, but the phascogales soon began to build up their own cosy nests, weaving in feathers, bark and leaves.

Common name: Red-tailed phascogale

Scientific name:
Phascogale calura

Noongar name:
Kenngoor

Closest relatives:
Brush-tailed phascogale and northern brush-tailed phascogale

Family: Dasyuridae

Body size: Females up to 10.5cm long; males up to 12.2cm

Weight: Males average 60g; females 43g

Life expectancy:
Males less than one year; females up to three years

Gestation period:
28–32 days, with a maximum litter size of eight young

Other facts

- Females don't have a pouch, as such, but a fold of skin that protects the young.
- These nocturnal marsupials have extra sensitive hearing because they have an enlarged auditory bullae – a bony cavity enclosing the inner ear – that helps them hear small moving prey.

Conservation status:
IUCN: Near threatened
Federal: Vulnerable
WA: Conservation dependent
NSW: Extinct
VIC: Vulnerable
SA: Endangered
NT: Extinct

Importantly, the reserve isn't fenced, meaning it's a true wild-to-wild translocation. "Captive-bred animals can lose some of that survival instinct, so they're more naive to predators," Genevieve says. "Wild-to-wild translocations tend to be more successful because the animals just know what to do."

Predation remains one of the greatest threats to the red-tailed phascogale across its range, and Kojonup Reserve is no exception. The reserve is regularly managed for wild foxes and cats, primarily using 1080 baiting. But even with these threats, the population at Kojonup has met all the success criteria for the translocation. Genetic studies show good diversity – essential for long-term survival – and monitoring indicates ongoing breeding. "We can't say exactly how many are there now," Genevieve says, "but all signs point to a healthy, stable population."

The work doesn't stop there. Genevieve and her colleagues are applying the lessons learned at Kojonup to a large landscape restoration initiative – the Fitz-Stirling macro corridor – connecting two national parks across private and conservation-owned lands. "Red-tailed phascogales also exist near that corridor, and we're hoping to see signs that they're moving back into areas where they've been absent," she says.

You can support Bush Heritage's wild translocation program at Kojonup by donating to our Australia's Most Endangered campaign in July and August, which will raise vital funds for the truly extraordinary red-tailed phascogale. ■

Visit our website or scan the QR code to donate today

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STORY BY **CLARE WATSON**
PHOTOGRAPHY BY **STEPHANIE SIMCOX**

SKIN IN THE GAME

This Aussie actor has turned her back on a successful Hollywood career to work with her new extended neighbourhood south of Sydney on creating a sustainable future.

LIKE SO MANY Australians, Yael Stone was left reeling after the 2019–20 Black Summer bushfires that razed much of the east coast. Her anxiety flared, and she began to ask herself what she could do in response.

Yael soon found her focus in the history and people of the city she'd recently moved to: Wollongong, in the Illawarra region just south of Sydney. But her idea to launch a not-for-profit organisation called Hi Neighbour – to help locals upskill for clean-energy careers – came after much rumination.

Her immediate reaction to the bushfires was very public. The Sydney-born actor, famed internationally for her lead role in the US-based television series *Orange is the New Black*, decided at the height of her career to turn her back on Hollywood. She relinquished her green card, which allowed her permanent residency in the United States, because she felt she couldn't justify the carbon cost of flying back and forth to Australia. "It's unethical for us to set up a life in two countries," Yael said on social media, explaining that giving up her green card was a way she could put "skin in the game".

But it took Yael longer to figure out what she could do to make meaningful change. She had settled in the idyllic northern suburbs of the Illawarra with two young kids filling her days. She began studying a Bachelor of Sustainable Communities at the University of Wollongong, trying to find a solution for hers. She was arrested for painting a mural as a climate protest action on the beachside wall of Thirroul's public pool, near ►

After the Black Summer bushfires, Yael Stone asked herself: 'What can we do about it?' Her answer was to start local.

where she now lives. But none of that provided the sense of purpose she was looking for.

"I had to go to court," Yael says. "And I thought, 'Have I really brought people together?' I have great admiration for people out there who are doing disruptive protest work to draw attention to this critical moment [of the climate crisis]. But my desire was to bring people together."

The wish to unite her community was fuelled by what she saw up close in the 2016 US election: the division it stoked between city and country, between old industries and new futures. It broke her heart, she says, to see that divide exploited, and she couldn't bear to see the same thing happen in Australia in the ashes of the Black Summer bushfires.

Yael crossed the divide from big city to industrial heartland many times as a child. She was born and raised in inner-city Sydney but spent much of her childhood in Newcastle, where her grandfather, Tom, worked in steelmaking. Long before she reached Hollywood, she'd also journeyed south to Wollongong as a teenager, taking the train that winds its way down the Illawarra escarpment and past the Port Kembla Steelworks.

Accusations hurled at the coal industry after the bushfires didn't sit well with Yael, although she appreciates the science that says the burning of fossil fuels needs to end to stop climate change. And she was shocked by the wider lack of support for her own local community on the so-called Coal Coast, where coalmining and steelmaking have been woven into the social fabric for more than a century. Reminded of her own family's industrial past in the Hunter, Yael was inspired to help Illawarra workers find new job opportunities in the fast-developing renewable-energy sector.

"I really like the workforce that grows up around industry. They're practical people; people who have real hands-on skills."

"There was a period [after the fires] where we were pointing fingers at workers in the coal industry, and it just felt like, wow, we're targeting the wrong group [of people] there," Yael says. "We should be utilising all that industrial skill and grit, and certainly shouldn't be turning our back on a workforce that has done all that hard work to keep the lights on."

And so, in early 2023, she launched Hi Neighbour. Starting small and staying local, the not-for-profit has, through its scholarship program, so far helped 10 electricians become certified solar and battery installers, and is supporting eight women to further their careers in renewables. Among them are apprentice electricians, engineering students and project managers whose skills are in demand. The awardees of a First Nations scholarship, First Power, will soon be announced too.

"The idea of Hi Neighbour was really about highlighting that local wellspring of community power that will see us rise above the politics and work together," Yael says. "We can't leave anyone out."

The name Hi Neighbour stems from Yael's experiences on her own street, which sits tucked under the escarpment with glimpses of the ocean – and where, despite their wide spectrum of views, neighbours still manage to find common ground and help each other out. The old adage rings true, it seems. "When it really comes down to the stuff of life, as we've seen in recent bushfires and floods, it's your neighbours who are there for you," Yael says.

THE ACTOR'S DEEP appreciation of industrial work can be traced back to her steelmaking Novocastrian grandfather, and her father, Harry, who was a builder and an architect. "I really like the workforce that grows up around industry," Yael says. "They're practical people; people who have real hands-on skills." Even so, she admits she didn't fully appreciate the Illawarra's coal-powered history when she first moved to the area.

The place felt deeply familiar – a coastal town built around steelmaking and heavy industry, much like Newcastle. But after the Black Summer bushfires, she was taken aback to see the local primary school's insignia emblazoned with a lump of burning coal bearing the motto *From darkness to light*. "It took me living here, speaking to people outside my social circle, to understand what that [coalmining history] really means to this community," Yael says. "Folks who went underground risked their lives. Very young people did that for a lifetime of work in these very treacherous environments. And there was a sense of pride around it because it was deeply dangerous work."

The Illawarra, in fact, still bears the scars of Australia's worst mining disaster – an explosion that struck the Mt Kembla colliery in 1902, claiming the lives of almost 100 young men and boys. Fathers died alongside sons, and the ghost of at least one coalminer is said to have taken up residence at the Heritage Hotel, a pub around the corner from where Yael now lives.

"Our local myths and legends are around coal, so there's this deep cultural placement of that [industrial] work everywhere we look," Yael says. "I'll never pretend to be a true local, but I've come to understand the community more."

OVER TIME, YAEL has also learned to embrace being a novice in the climate-advocacy space. She says being upfront about what she doesn't know helps her forge genuine relationships with people she might not otherwise connect with. "You don't have to come into this space and know everything," she says. "But you do have to talk to people and learn."

And yet, despite all the conversations she has had around town, Yael was caught off-guard by the vocal opposition in some parts of the Illawarra community to the offshore wind zone proposed for the region's striking coastline (see '*Green is the new black*, page 98). She didn't realise how far that community division had already gone, she says, until she was invited to

Yael and her young child get their feet wet in a coastal pool near their Illawarra home.

speak at a fiery town hall meeting organised by local MP Alison Byrnes during the consultation period. The zone has since been approved by the federal government, albeit at a reduced size and further out to sea than originally proposed.

"We still have a lot of work to do to bring people together," Yael says, reflecting on that period of intense community debate. "[The Illawarra] is a magical place where the relationship between the sea and the escarpment is so intimate." Knowing that, she now understands why people may be concerned about how a new offshore wind industry could impact the ocean, even if she and some of her fellow locals are at odds about the best way forward.

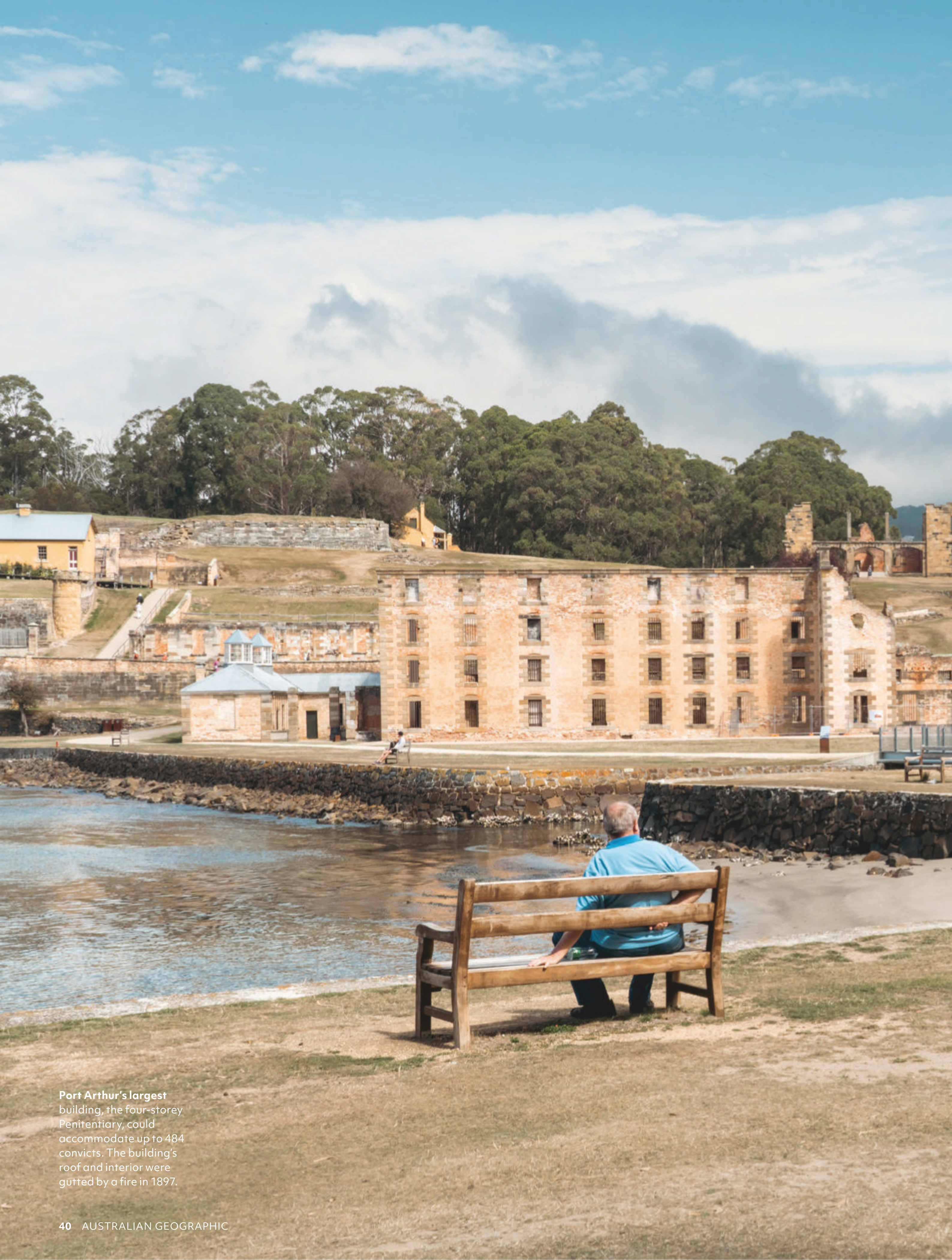
"People who have been here for a long time seem to really know the value of the place," Yael says, and adds that not involving them in conversations about the region's future would be a massive misstep. The community needs to be involved, she continues, in discussions about the benefits and opportunities of building renewable energy industries: "When we don't bring the community along for the ride, that's when we see fragmentation."

Yael believes the antidote starts with one-on-one conversations. "[The Illawarra has] an amazing opportunity to come together, to be proud of our past and get ready for our future – and welcome a future that's really positive," she says. "It doesn't have to be one or the other. There can be space for everybody. This is a whole-community transition."

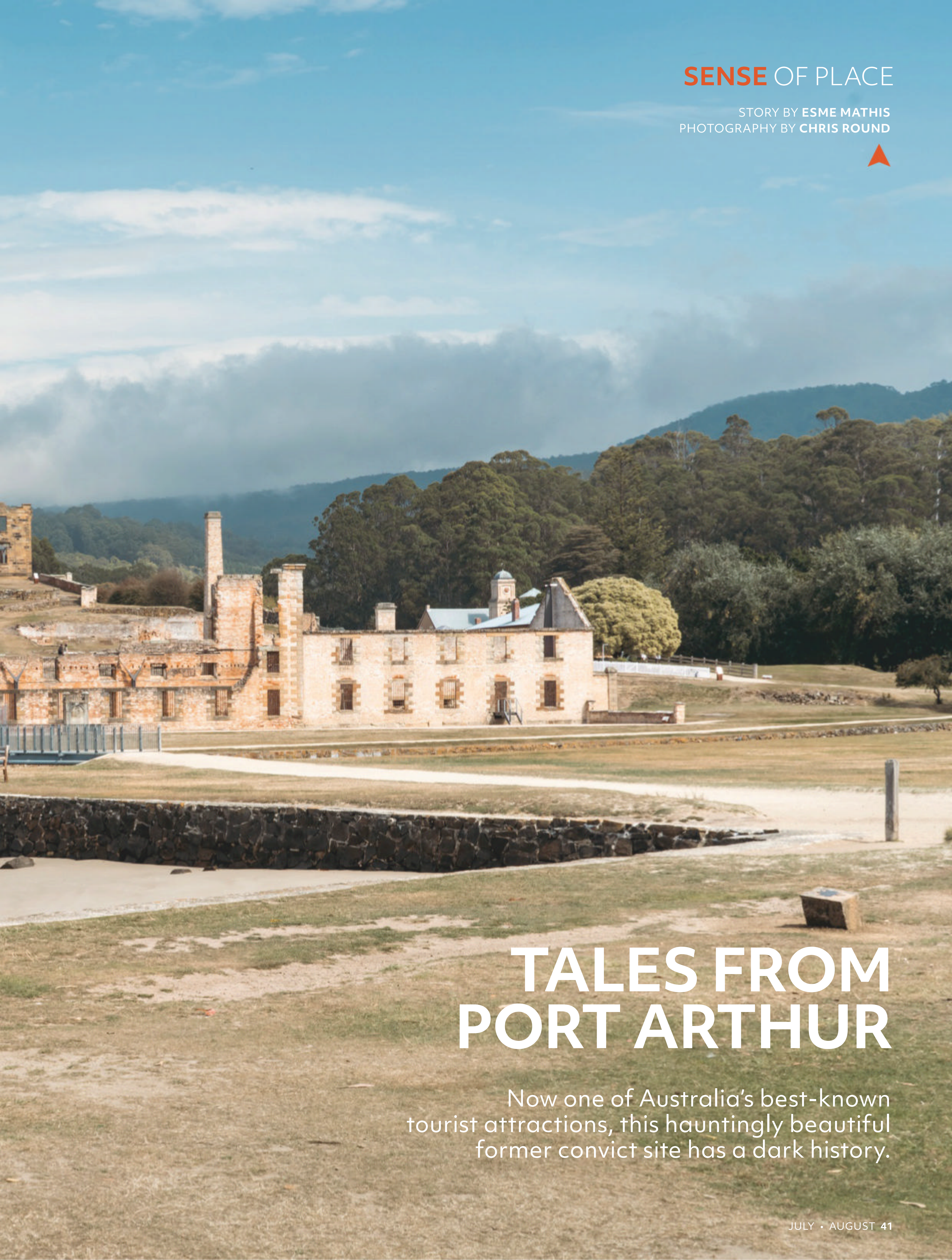
In her work with Hi Neighbour, Yael has focused on building unlikely connections between workers and employers, businesses and community so they can all share in the benefits of the renewable-energy transition. Scholarship awardees are also paired with mentors to help guide them through their careers. "That's what I'm proud of – the network that we've built," she says.

On a more personal level, staying focused on her local sphere of influence has helped Yael ease her own chronic sense of impending environmental doom. "I was in a really bad way in terms of my climate anxiety in 2020, and that's when I started doing what [I am] doing," she says. "[Hi Neighbour] has been a great way for me to meet it head on and go, 'Okay, cool. [Climate change] is happening. What do we do about it?'

"The other thing is just the great generosity of spirit that I've come across on so many levels – in the community, but also people in business, people in government and other not-for-profits." While it can be easy to despair at the slow progress on climate change, she finds the key is to keep coming back to her local community. "It happens again and again," Yael says, "people just being thoughtful and helping me out. That has been particularly heartening." ■



Port Arthur's largest building, the four-storey Penitentiary, could accommodate up to 484 convicts. The building's roof and interior were gutted by a fire in 1897.



SENSE OF PLACE

STORY BY **ESME MATHIS**
PHOTOGRAPHY BY **CHRIS ROUND**

TALES FROM PORT ARTHUR

Now one of Australia's best-known tourist attractions, this hauntingly beautiful former convict site has a dark history.

PORT ARTHUR HISTORIC Site's reputation precedes it. The name 'Port Arthur' alone evokes a strong emotional response for many Australians due to its connection to two dark yet formative chapters in our nation's history. Two centuries ago, it was a harsh secondary punishment station for male convicts, and almost 30 years ago it became the site of a horrific massacre that claimed the lives of 35 people. But despite its bleak history and remote location on the southern end of the Tasman Peninsula, Port Arthur is one of Tasmania's most popular tourist attractions, bringing hundreds of thousands of visitors each year.

Port Arthur is Australia's largest and best-preserved convict site, with more than 30 buildings and ruins scattered across the 100ha settlement including guard towers, a penitentiary, churches and private cottages. The surrounding landscape is physically beautiful and features gardens, towering sea cliffs and a harbour surrounded by forest. Thousands of people lived here during its European history, from boys and petty thieves to violent criminals. Priests, soldiers, civil servants and wives and children also lived at the penal settlement.

Colin Knight has spent more than 30 years working as a guide at Port Arthur, and over the course of his lifetime he has seen public opinion towards Australia's convict past shift from shame to a cornerstone of our national identity. "The attitude to convicts generally in this country has changed considerably," he says, citing Robert Hughes' bestselling 1986 book *The Fatal Shore,* and the 1988 bicentenary, as two major turning points. "Now, people actively look for convicts in their past, whereas earlier generations, of course, denied the fact," he says.

Colin admits he doesn't have a convict in his family tree, but he still feels a strong emotional connection to Port Arthur. You don't need convict heritage to be moved by the stories of hardship attached to this place and appreciate the resilience of the men and boys who passed through.

PORT ARTHUR WAS founded in 1830 as a timber-getting camp. In 1833 it became a secondary punishment station for reoffending male convicts from across the Australian colonies. "Secondary punishment was the very bottom rung of the convict system of Van Diemen's Land," Colin says. "It was a harsh place."

Port Arthur's bleak reputation has survived into the 21st century. Stories of cruel punishments have endured longer than many of its physical buildings, boosted by Marcus Clarke's 1872 bestselling novel *For the Term of His Natural Life* (which Colin describes as a bit of "an improbable soap opera").

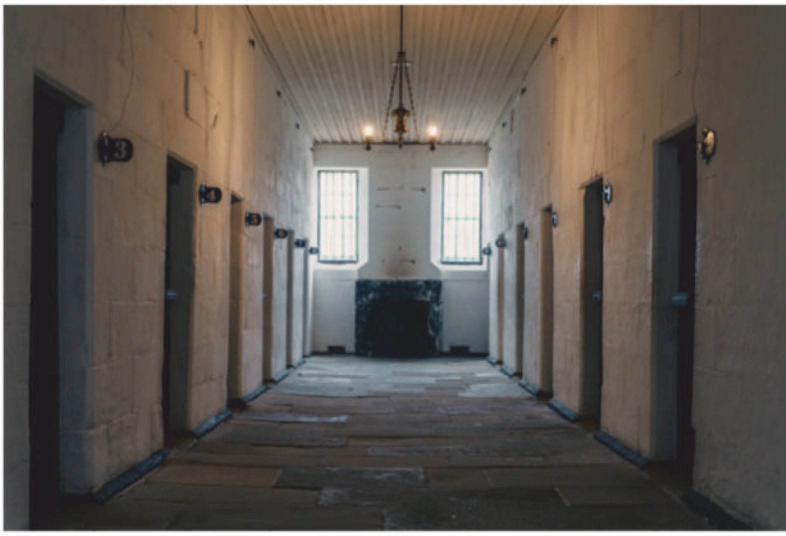
The Separate Prison is arguably Port Arthur's most notorious building. Convicts interned in this prison, completed in 1852, were subject to separate treatment: total solitary confinement – sometimes in windowless, pitch-black cells – in absolute silence. To increase their isolation, convicts wore hoods over their heads when walking to and from the chapel and watched the services from individual cubicles. It was hoped the silence would encourage introspection, and that the social isolation would distance convicts from the corrupting influence of other inmates. "A young person in a prison can learn how to be a better criminal simply by being in prison, so the solitude and separation was part of trying to break that criminal culture and the criminal learning," Colin says. "The silence was also there, whereby a person would contemplate past misdeeds, meditate upon these, and, with religious [instruction], reformation would be generated from within and therefore might be more permanent. It was fairly ambitious thinking."

The dreaded Separate Prison reflects Port Arthur's more experimental side: it was a place that sought to reform criminals, not just mete out punishments. Colin quotes English philosopher Jeremy Bentham when he says Port Arthur is "best described as a 'machine for grinding rogues honest'". Put simply, criminals could be moulded into respectable citizens through hard work and moral instruction.

"The idea of this machine is you feed these people into it, and it grinds away, and out the other end – hopefully – a more compliant, more malleable contributing citizen to the new colonies emerges," Colin says. "The consequence of that not working is they were simply fed back into the machine, which continues grinding."

Port Arthur provided reoffending convicts with the skills needed to achieve a better life. Convicts there were taught to read and write, and many also learned a trade. By the 1850s, the

The cosy, homely interior of Trentham Cottage (above) feels worlds away from the nearby Separate Prison (below), where convicts endured some of Port Arthur's harshest conditions.



Tourists explore the ruins of the Penitentiary, where only the masonry walls and barred windows survive.

It was a place that sought to reform criminals, not just mete out punishments.

site had expanded to a 40ha industrial penal settlement, with convicts engaged in all manner of trades from shoemaking to smithing, brickmaking and shipbuilding.

A convict's experience at Port Arthur often hinged on their behaviour: good behaviour could result in learning a trade and early release; bad behaviour landed them in Separate Prison. Early release was the ultimate incentive. Colin says a common misconception is that a reoffending convict was sent to Port Arthur and left 'for the term of his natural life'. In reality, a well-behaved convict could be discharged from Port Arthur within two or three years – and, having learned a trade and basic literacy, embark on a new life.

"Now, it's then up to them to stay on that path," Colin says, "and of course, if they don't, they can end up back here – or, even worse, on Norfolk Island. So, that possibility was there: if [they] wanted freedom and, essentially, a better life, it was still available…if they followed the specific guidelines of obeying rules and regulations, and working hard." Colin says whether or not this was successful is a matter of prolonged debate.

One of Colin's favourite sites at Port Arthur is Point Puer, a probation station for boys that operated from 1834–48 across the harbour from the main penitentiary area. It was the first purpose-built prison for boys in the British Empire and had nearly 800 living there at its peak. "The good thing about Point Puer was it got the kids out of the clutches of adult criminals, and that got them away largely from their influence," Colin says. "A problem with Point Puer was it never had the resources that would have been necessary to make it work better."

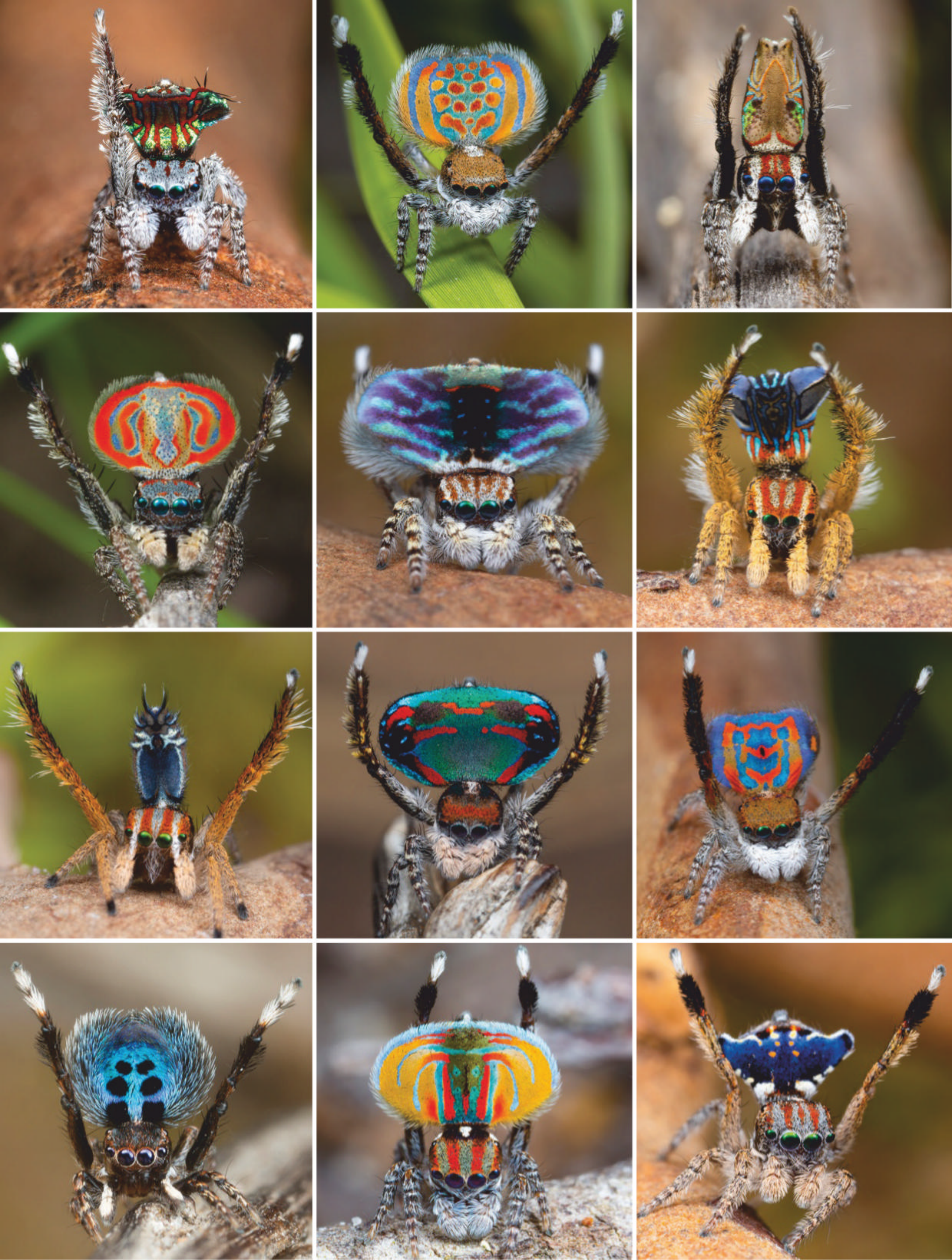
Disciplining the boys and keeping them in line was no small task. Colin describes these wild, tough-as-nails street children as "the Artful Dodgers". The idea, as with adult convicts, was to teach them a trade and a semblance of education then set them on their way. "A few probably made it, and some of them didn't, of course," Colin says. "Many of the boys carried the stigma that they'd been at Port Arthur into their life after they'd been released. Technically, Point Puer was a probation station; it was located at and administered by Port Arthur, but technically it wasn't part of it. But that, of course, made no difference to the people who encountered these young men as they grew up – they simply knew that they'd been at Port Arthur."

During the 1860s Port Arthur entered a slow decline. The Pauper's Depot and Asylum were built to house the destitute and mentally ill. The Pauper's Depot was the first of its kind in the Australian colonies. When Port Arthur closed in 1877, the site quickly became a tourist attraction. Some convicts returned here and for a small fee would tell stories of their horrifying experiences.

ON 28 APRIL 1996 a gunman entered Port Arthur's Broad Arrow Cafe with three semi-automatic rifles. He then murdered 35 people and injured dozens more. The incident sent shock waves around the world and proved to be a watershed moment for Australia. As the nation grieved, the public united in overwhelming support for tighter gun control, including a total ban on automatic and semi-automatic firearms. Then-prime minister John Howard swiftly introduced the National Firearms Agreement that banned a number of firearm types, tightened gun-ownership legislation and introduced a buyback scheme that saw more than 650,000 firearms surrendered to the government to be melted down.

Today, the victims of this still very raw tragic event are commemorated in a memorial garden at Port Arthur Historic Site. The memorial, near the ruins of the Broad Arrow Cafe and surrounded by a garden, features a plaque of the names of the victims and a reflection pond. Colin says it's where people can sit quietly and reflect on the tragedy. "We have a garden around it…to give the people who are in the memorial garden that sense of separation [from] the herds of people walking past," he says.

Colin says tourists at Port Arthur are generally respectful. "They remain curious, of course, and we get [asked] questions," he says. "But I have to say, the majority of our visitors are very sensitive to the events of 1996." ■



MORE THAN MEETS THE EYE

STORY BY **AMANDA FREEMAN**

Evolution hasn't only gifted peacock spiders with spectacular markings – these nimble arachnids are also remarkable athletes.

WHEN SYDNEY-BASED BIOLOGIST Dr Jurgen Otto became the first person to photograph a *Maratus volans* peacock spider's courtship display in 2008, he couldn't have known these tiny arachnids would one day become the darlings of the internet.

Jurgen first became fascinated with these remarkable spiders in 2005 after a chance encounter with one in bushland near Sydney. At the time, not much was known about these elusive jumping spiders; no one had observed the males' courtship displays, and females were still unknown to science. But Jurgen's once-amateur interest quickly snowballed into his life's passion. He has since published scientific papers, described new species, and even introduced them to world-renowned naturalist Sir David Attenborough. Today, his photographs and videos of male peacock spiders have taken social media by storm, racking up millions of views for their dazzling, iridescent colours and bewitching 'dance' moves.

His most-viewed YouTube video has more than 9 million hits. In the video, a male coastal peacock spider (*Maratus speciosus*) performs an elaborate courtship display, his emoji-faced abdomen held aloft as he waves his third legs in time to techno music. Watch this stunning spider dance, and you can't help but smile.

At Macquarie University's School of Natural Sciences, master's student Anna Seibel and her research supervisor, Associate Professor Ajay Narendra, are smiling too. Their high-speed camera reveals that, as well as having good looks and sharp moves, peacock spiders also hold their own in nature's Olympics.

Abdomens aloft, male peacock spiders of various species display their dazzling designs during courtship. Photo credit: Dr Jurgen Otto

Humans – with the notable exception of Marvel's Spider-Man – cannot compete with peacock spiders. Anna and Ajay have clocked the jumping acceleration of splendid peacock spiders (*Maratus splendens*) at a breathtaking 127m per second squared. In comparison, Usain Bolt's burst out of the blocks in his world record-breaking 100m sprint was a mere 9.5m/s^2.

As members of the Salticidae family (the jumping spiders), peacock spiders have it over us in the long jump too. Jumping spiders leap prodigious distances – often 10–15 times their body length. The 8.95m long jump world record, set in 1991 by US athlete Mike Powell, was an impressive leap of more than four times his own height. But if your average 1.75m Aussie bloke could leap like a jumping spider, he could travel across his street and into his neighbour's yard in a single bound. And if you can manage that, we'll see you in Brisbane in 2032!

IT'S ONE THING to clock human athletic records, but how do you measure motion in a tiny peacock spider? And how do you even get them to jump? Anna and Ajay have that sussed.

"We 3D-printed take-off and landing platforms that were 4cm apart," Anna explains. "Then we gently placed the spiders on the take-off platform and waited anywhere from a few seconds to a few minutes for them to leap over the gap. Sometimes they needed a little nudge to move."

Once a spider launched, fancy camera gear came into play. "Because the spiders jump so incredibly fast, we film them with [a] high-speed camera," Anna says. "It's like watching a slow-motion video."

The researchers attached a high-performance macro lens to their Phantom T1340 to catch the action at 5000 frames per second – about 160 times faster than the human eye can register. "The spider moves very fast during the jump, so we really need to freeze every little bit of movement," Ajay says. ►

Navigating his way behind the female, a male *Maratus unicup* (above) prepares to transfer sperm using his palps – multipurpose appendages near the front of his body. Photo credit: Flynn Prall

As a female moves closer to signal her interest, a male *Maratus cuspis* (left) peacock spider strikes a dazzling courtship pose. Photo credit: Michael Lun

Grasshoppers are fast-moving food, but this female shield-carrying peacock spider (*Maratus clupeatus*) caught its meal (below).
Photo credit: Flynn Prall

Then Anna and Ajay track the spider's body parts to chart its jump. "They have four pairs of legs, and we have to track every single leg joint, and [also track] the spider's centre of gravity," Ajay says. Frame by painstaking frame, a spider's jump, which happens in an instant, takes the researchers a few hours to work through.

But it's worth the effort. "We use that to characterise what they're doing throughout the jump; for example, the way in which the legs are extended can tell us about which legs are the propulsive pair," Anna says.

The way spiders move their legs to jump isn't the same way we do it. Mike Powell, Olympic hopefuls, kids using skipping-ropes in the school playground – we all use our muscles to power our leaps. Spiders aren't equipped for that. "They do have flexor muscles, so they can bend their legs," Ajay says. "But they don't have muscles to extend their legs. To do that, they use fluid."

Like most arthropods, spiders are filled with a blood-like fluid called haemolymph. When a spider wants to jump, it pumps this fluid down into the legs. "That straightens the legs out, which launches the spider into the air," Ajay explains. "Because they use hydraulic pressure, their jumps tend to be much faster than muscle-driven jumps."

"It's amazing," Anna says, "to think how these tiny animals, just 2–6mm in body length and weighing about 2mg, generate enough force, and enough acceleration, to actually jump like this."

WHY *DO* PEACOCK spiders jump? And why so speedily? Anna says there are several reasons. "One of the main reasons is to catch prey. They catch fast-moving prey like flies, ants and planthoppers, so being able to jump quickly is important," she says. "It also gives them an efficient way to move through the environment. For example, when crossing a gap, it's a lot faster and more efficient to jump across than to take a long detour by walking. They also, of course, jump to escape predators."

That predator could be a mate. "Male peacock spiders have to make a hasty retreat as soon as they finish courting, because the females are cannibalistic. They'll eat the male once they finish mating," Ajay says.

Like almost all the jumping spiders that have been studied so far, splendid peacock spiders use their third pair of legs to power their jumps. With such high stakes, the splendid peacock spider's mating display is therefore surprising. Because, as the millions of YouTube viewers know, jumping isn't all that peacock spiders use their legs for. Males also wave their legs during courtship.

"They get the common name 'peacock spider' because, just like peacocks, the males display and dance to females during courtship," Ajay says. "What we see in splendid peacock spiders is that, as well as for jumping, they also use their third pair of legs in courtship display. This may be the norm in all the peacock spiders, but at this stage, we don't know."

> **"Just like peacocks, the males display and dance to females during courtship."**

This multitasking must be challenging for a male splendid peacock spider. "He needs to display to attract the female, but if he needs to make a rapid escape, he has to rely on the same legs, which means he's going to lose time," Ajay says. "He has to stop waving, put his legs down, and then jump fast – because the female can jump and catch him."

Splendid peacock spider females are much larger than males of the species. They weigh a hefty 10mg on average, while the tiny males can weigh as little as 5mg. But those extra reserves that are needed for egg production mean females aren't quite as quick on the take-off as their suitors. Speed is on the male's side.

Nevertheless, as Spanish racewalker Laura Garcia-Caro learned at the 2024 European Athletics Championships, trying to move fast and wave at the same time can see you overtaken. "They've put all their eggs in one basket in terms of these two rather critical things they have to do," Ajay says of the splendid peacock spider's third pair of legs.

But more research is needed to understand the evolutionary trade-offs. "It could be that they've invested heavily into one pair that [is] longer, thicker and heavier, and can generate more power that allows for better jumps," Ajay says. "With tufts of hair, their third pair of legs also [has] a much larger surface area to use as a reliable signal when courting the female."

There's still much to learn about the jumping power of peacock spiders and their relatives. "All we've done at this stage is look at locomotion," Ajay says of the controlled jumps the researchers have observed in the lab. In the wild, however, jumping spiders live in all sorts of cluttered habitats where they leap for all sorts of reasons. Escape jumps, or jumps that spiders make when they're startled, are likely to be much less directed – and probably even faster, as Anna, Ajay and their colleagues proposed recently in the *Journal of Experimental Biology*.

And then there's endurance. In the lab, Anna and Ajay studied single jumps, but jumping spiders often jump multiple times in a row. Whether leaping their way through the arachnid equivalent of a marathon alters the mechanics of individual jumps is unknown, and how peacock spiders would fare in the triple jump event is yet to be determined. But they'd probably make the 400m hurdles on an Olympic track look like a Sunday stroll.

Watch this space. Besides the quivering courtship dances for which peacock spiders are renowned, these sporty arachnids are living their lives with a level of athleticism our Olympic heroes can only dream of. Too bad they can't go for gold in Brisbane. ■

COLOURFUL CHARACTERS

There are more than 100 species of peacock spider in Australia, but there are almost certainly more to be discovered. Back in 2011, just seven species were known to western science. Most occur in subtropical and temperate regions in southern and eastern Australia in a range of habitats from coastal forests and scrublands to grasslands and open woodlands. Some – such as the critically endangered Sarah's peacock spider (*Maratus sarahae*), known only from Western Australia's Stirling Range – have very restricted distributions.

A peacock spider's life span is up to a year. Individuals hatch from an egg during summer and go through several moults before adulthood. These spiders don't build webs but rely on stealth and speed to hunt small insects and other arthropods. They're harmless to humans, but, like most spiders, they have venom for subduing and killing prey.

These tiny spiders, typically 2–6mm long, flew under the radar for most of the 20th century.
Photo credit: Dr Jurgen Otto

WILDLIFE WONDER DOWN UNDER

STORY BY **LEE MYLNE**

The prestigious Wildlife Photographer of the Year exhibition has opened at the Australian National Maritime Museum in Sydney, on loan from the Natural History Museum in London.

NOW IN ITS 60th year and widely considered 'the Oscars of wildlife photography', the world-renowned Wildlife Photographer of the Year competition captures images of fascinating animal behaviour, spectacular species and the incredible diversity of the natural world.

Canadian marine conservation photojournalist Shane Gross was awarded Wildlife Photographer of the Year 2024 for his image *The Swarm of Life*, a breathtaking photograph that shines an underwater light on the tadpoles of North America's western toad.

Images in 18 categories showcase earth's rich biodiversity and highlight the challenges wildlife face today. Three Australian photographers were either category or award winners.

Matty Smith, based in Newcastle, New South Wales, won the Underwater category for *Under the Waterline*, an image of a curious leopard seal beneath the Antarctic ice. As co-founder of Wild Planet Expeditions, Matty was aboard a 60ft yacht running a photography tour in 2023 when he took his winning shot.

"We were in a place called Paradise Harbour on the Antarctic Peninsula and this leopard seal started following the boat," he says. "We took the opportunity to get into the water, and he was relaxed and friendly – but still intimidating at around 350kg and about 12ft long. The light was fading quickly, but he hung around and then came towards me, looked straight down the barrel and I took just a couple of frames. It was a split second in time."

The underwater split shot, showing both above and below the water, is a signature style for which Matty has garnered many international awards. It was taken with a Nikon Z7 with a Nikon 14-30mm lens.

Justin Gilligan, who lives and works on Lord Howe Island, was the winner of Oceans: The Bigger Picture with *A Diet of Deadly Plastic*, creating a grim mosaic from the 403 pieces of plastic found inside the digestive tract of a dead flesh-footed shearwater.

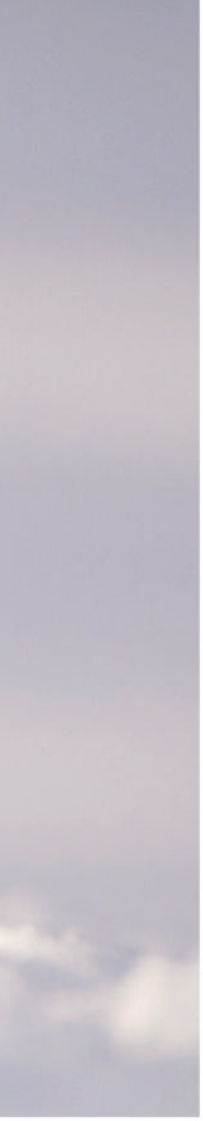
Aside from the categories, Brisbane-born Jannico Kelk won the Impact Award with his image *Hope for the Ninu*, showcasing a greater bilby (Ninu) in a fenced reserve.

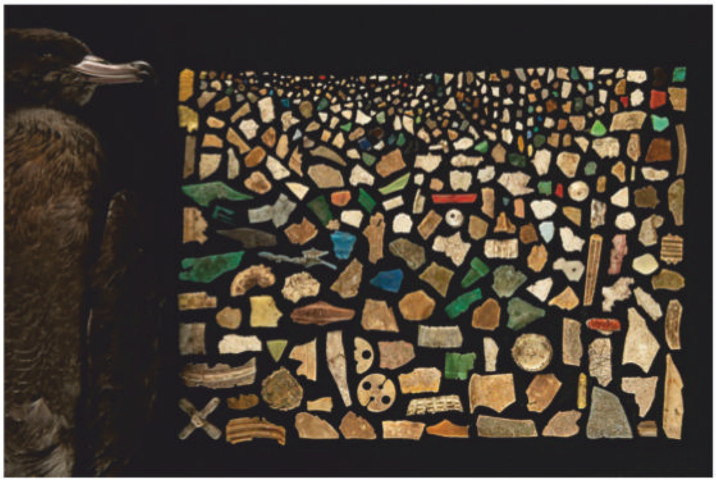
The Young Wildlife Photographer of the Year 2024 title was awarded to Alexis Tinker-Tsavalas, from Germany, for his up-close image *Life Under Dead Wood*, depicting the fruiting bodies of slime mould and a tiny springtail.

Wildlife Photographer of the Year is developed and produced by the Natural History Museum, London. Running since 1965, today the competition receives entries from all over the world. This year's competition attracted 59,228 entries from photographers of all ages and experience levels from 117 countries and territories. Entries are judged anonymously on creativity, originality and technical excellence by an international panel of industry experts.

Ms Daryl Karp AM, museum CEO and director, says Wildlife Photographer of the Year is a perennial favourite with Australian audiences. "These are powerful, beautiful and perfectly timed images that surprise, inspire and amaze," she says. "There's no better space to lose and immerse yourself in this planet's natural world."

The exhibition runs until 19 October at the Australian National Maritime Museum.

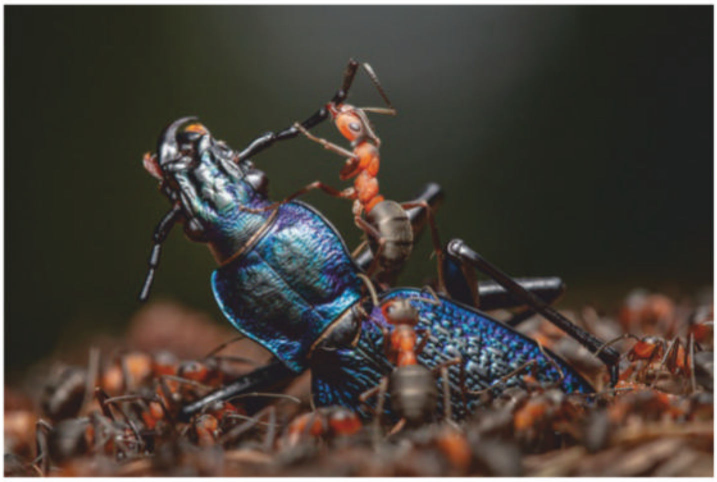




Justin Gilligan, Australia, created a mosaic from the 403 pieces of plastic found inside the digestive tract of a dead flesh-footed shearwater for *A Diet of Deadly Plastic* (top right), which won the Oceans: The Bigger Picture category.

The Demolition Squad, (right), by Ingo Arndt, Germany, winner of the Behaviour: Invertebrates category, documents the efficient dismemberment of a blue ground beetle by red wood ants.

Twist and Jump (left), by Jose Manuel Grandío, Spain, captures a stoat mid-air in the French Alps and was Highly Commended in the competition.



Under the Waterline
Matthew Smith
Winner
Under Water

Matty Smith, formerly of the UK and now based in Australia, won the Underwater category with his image of a curious leopard seal beneath the Antarctic ice.

Wildlife Photographer of the Year

Until 19 October 2025, Australian National Maritime Museum, 2 Murray Street, Darling Harbour

REGIONAL INNOVATIONS

In this three-part series, AUSTRALIAN GEOGRAPHIC explores how innovative minds in Australia's regions are proving that remote areas are hotbeds of ingenuity – and are helping to shape our nation's economic future.

Mia Ryan created a dating app to help bridge the gaps faced by rural singles across Australia.
Photo credit: Duncan Wright

ESTABLISHING A CONNECTION

STORY BY **MANDY MCKEESICK** AND **ADAM SCROGGY**

Regional entrepreneurs are battling to overcome the many roadblocks associated with distance and isolation.

IN THE HORSE haven of the Hunter Valley, Mia Ryan is training a warmblood under the wide skies of rural New South Wales. She flicks her long hair behind an Akubra as she works the horse on a long rein. It's quiet work – repetitive, intuitive, physical – typical of life in the country. But behind the scenes, 23-year-old Mia is also navigating the fast-paced and rapidly evolving digital world, developing a dating app uniquely designed for rural people, by someone who truly understands the challenges of remote life.

Mia's creation, Howdy, emerged from a personal need. Frustrated by mainstream dating apps, which she sees as predatory dopamine dispensers engineered more for profit than genuine connection, Mia built a platform that slows things down, encourages commitment and breaks down geographical isolation.

That sense of isolation driving Mia's work doesn't just apply to love. It's a familiar challenge for entrepreneurs throughout regional Australia. Founders working outside the big cities face unique hurdles – from patchy internet connections to the tyranny of distance and small, dispersed markets. It's a landscape where resilience and creativity are essential.

Entrepreneurs in these areas often find themselves working in isolation, disconnected from broader networks and policy frameworks that still default to urban models of growth. This is compounded by digital exclusion: a 2022 RMIT study found mobile data speeds in some remote towns are up to 90 per cent slower than in cities. With unreliable broadband and the high cost of prepaid data, founders face a hard ceiling on their growth, making it challenging to test products and reach markets.

The barriers are even steeper for regional women. While women now make up 22 per cent of Australia's start-up founders, just 0.7 per cent of private-sector funding went to solely women-founded companies in FY22, according to Deloitte's Accelerating Women Founders report. This isn't due to lack of capability, the report says, but to historical biases – especially the practice of 'pattern matching' where investors favour profiles resembling past successes, typically male-led enterprises.

"We will not be able to reach our full growth potential with Australian start-ups if we fail to leverage half the population," the report reads. "Increasing diversity is vital to innovation and start-up growth…the OECD expects the benefits of leveraging the untapped potential of women entrepreneurs to include boosting economic growth by up to two per cent of global GDP."

WHILE MIA IS working on the problem of social isolation, Andi Lucas is tackling another challenge rural Australians know too well: housing. And she's doing it with the help of hemp.

In Cressy (population 1200), in Tasmania's Northern Midlands, where travellers from around the world come to fish for trout beside the Great Western Tiers, the cultivation of hemp is well-established. In Australia, hemp is defined as cannabis with a tetrahydrocannabinol (THC) content (the stuff that makes you high) of less than 1 per cent – far below the threshold for a psychoactive effect – and it's mostly grown for its seed, which is used in nutritional and medical applications. But increasingly, hemp is being looked at for its construction potential.

Turning hemp waste, such as the stalks and trash left over from harvest, into an industrial product is an emerging industry. And leading the charge is X-Hemp, an all-woman-owned-and-run hemp mill. It's the only hemp mill in Tasmania, and one of a handful across Australia.

Andi founded X-Hemp during the COVID years, but its inspiration can be traced back to her experience of housing insecurity years earlier. She was working in the TV and film industry, splitting her time between Tasmania and Boulder, Colorado in the USA, when disaster struck.

It was the summer of 2013, and fierce fires were consuming Tassie. Half the buildings in Dunalley, in the state's south-east, were destroyed – including Andi's home. "I felt fortunate – if ►

Cattle farmer turned matchmaker Mia knew she was unlikely to find love on traditional dating apps – so she took matters, quite literally, into her own hands.
Photo credit: Duncan Wright

“We’ve been operating on a shoestring. I’ve raised money through sheer bloody-mindedness.”

you can say that when you’ve lost all your wealth and possessions – that I had a second residence in Boulder,” Andi says.

But nine months later, her US home was destroyed in the catastrophic September 2013 Colorado Floods. Andi had lost both of her homes in less than a year.

“The fire and the flood sharpened my focus, and I decided the three things most important to me were the climate crisis, housing security, and empowering women financially,” Andi says.

After the US Government deported her in 2019, Andi returned to her hometown of Launceston and found hemp was a solution to her newly defined objectives. And nearby Cressy was the perfect site.

Construction materials made from hemp are non-toxic and can sequester carbon, giving them a lower environmental impact when compared to traditional building products. Especially pertinent to Andi, they are also fire-resistant. It ticked the box for Andi’s first goal of creating more resilience in housing as a part of climate-change mitigation.

Andi has built two houses as hemp showcases, which are now let on Airbnb. “They are constructed from hemp, have hemp linen, hemp gin in the mini bar, hemp food in the fridge and hemp mulch on the gardens,” Andi says.

In line with Andi’s stated focuses, X-Hemp is also working to create economic opportunity for women, employing nine locals. “I’m passionate about making sure women are actually rewarded for the enormous unpaid contributions we make to keeping civil society together, so I pay well above award and offer family-friendly hours,” Andi says.

But as ever, regional innovation doesn’t come without challenges. Hemp has additional compliance and regulatory constraints, because even with no drug value it’s considered a narcotic, and accessing funds to grow the business is a limiting factor. X-Hemp received $480,000 via the Boosting Female Founders grant scheme, and Andi has personally sourced $2.4 million through two crowdsource equity raises. “But in Australia, less than 1 per cent of venture capital went to female-led companies in 2023,” Andi says. For the scale she hopes to achieve, it’s nowhere near enough. “We’ve been operating on an absolute shoestring. I’ve raised money through sheer bloody-mindedness.”

Andi’s perception of the challenges facing females in the innovation landscape is given weight by Julia Spicer, former Queensland Chief Entrepreneur (see *On the snail trail*, AG 186). During her chief entrepreneur tenure, Julia commissioned research that showed the Queensland economy would have an extra $1 billion if female-led businesses were funded and got the same capital investment as male-led businesses. At an Australian level, the figure was close to $44 billion.

“Often, in regional areas, it’s the women who are innovating to find off-farm income – but they have a harder time getting access to venture capital,” Julia says. “What’s worse is the research also shows if those women received their first investment through female-focused funding, then they would be less likely to get future mainstream investment. So, we can feel damned if we do and damned if we don't."

IN RURAL AREAS, where isolation is a fact of life, the search for connection – in love and in work – can be especially tough. For her part, Mia knew she was unlikely to meet a partner on a traditional dating app. "Urgh," she says of those. "They've been created to make money, and their psychology is the same as gambling. It's about giving people dopamine highs, giving them a rush, and then obviously the big low, which makes them stay on there to get the next high. Dating apps are not created to help people."

Mia is aware of the mental-health struggles often faced by rural people, who may be geographically isolated. She also had a tough time meeting people who understood her rural lifestyle. Her solution was to create Howdy.

Traditional dating apps are quick. A picture and a job title. An instant decision. A swipe left or right. Move onto the next profile. "It can be really disheartening and there are people who have no intentions of meeting someone [for a long-term relationship] – it's just a hook-up culture," Mia says.

Howdy slows down the search and asks for commitment. It's subscription-based. The profiles are longer, encouraging time to get to know someone a little better. An instant decision isn't required. Best of all, there's no set radius to finding love; a search can be made across the entire country. "When you're living in remote areas, a 100km radius means the gene pool can be pretty small," Mia says, laughing.

Mia started Howdy when she was 21 and had to make a commitment herself to develop and launch the app. She took out a bank loan, engaged a lawyer, talked trademarks and leaned on her mother's small-business experience.

Howdy is unapologetically rural and with it comes humour crafted in the open spaces of the bush. Those looking for love joke they are also looking for gate-openers or have burning questions such as the preference for cowboys or ploughboys, motorbikes or horses. First dates have been spent in tractor cabs during harvest. Those meeting for the first time have travelled five hours in opposite directions to meet in country towns. Staff at produce stores point 40-year-old reclusive farmers in Howdy's direction. Mia even met her own partner – a farmer from Uduc, Western Australia – through Howdy. They chose neutral ground for their first meeting, at Beef Week in Rockhampton, a hub of all things rural. Now they rack up frequent-flyer points travelling between NSW and WA.

As Julia stresses the need for country and city to work better together, Howdy is facilitating its own meetings. "Two lawyers from Sydney have connected with country men through Howdy," Mia says. "One is dating a farmer from Victoria, the other is dating a farmer from WA, and the lawyers are already making plans to relocate."

She looks to her future with optimism, and that future includes Howdy. "In 10 years' time I would like Howdy to be the go-to dating app – and it will have gone global," she says.

BUT EVEN WITH humour, hope and sheer grit driving projects such as Howdy and X-Hemp, the bigger picture remains clear: there's a systemic gap to be bridged if these rural founders are to reach their full potential, and for the Australian economy to reach its potential in turn. Deloitte's Accelerating Women Founders report lays this bare.

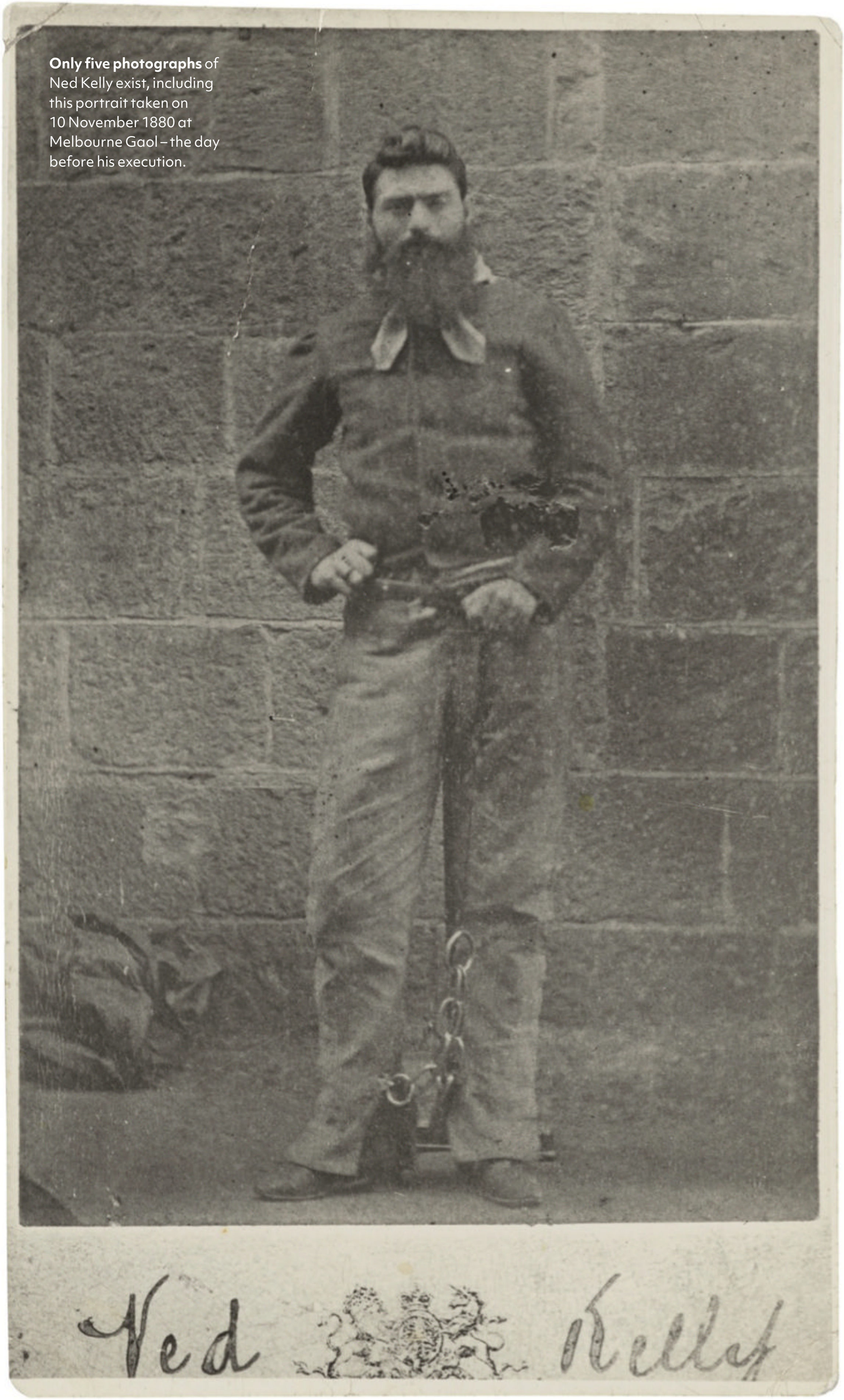
"For every dollar of funding, research finds that women-founded start-ups generated 78 cents of revenue, compared to 31 cents for male-founded start-ups," the report reads. "It is more important than ever for the ecosystem of support for women entrepreneurs to be appropriately resourced and designed – including for scale-ups. Shifting the dial in the gender funding gap will require more co-ordinated action and commitment to change among government, universities, business support programs, investors, and industry and corporate programs. But programs and networks like SBE, Heads Over Heels and Scale Investors are testament to the impact that can be made by directly supporting women entrepreneurs in Australia."

Mia's work in bridging distance and isolation through Howdy is a powerful metaphor for the work ahead in Australia's innovation ecosystem. Howdy is proof that meaningful connections are possible, even across thousands of kilometres of red dirt and farmland.

That same energy – of seeking out those on the edges and valuing what they bring to the table – shows the way to a more connected, inclusive innovation landscape that draws strength from all corners of Australia. ■

X-Hemp founder Andi Lucas (left) believes hemp holds the key to more affordable, resilient housing in vulnerable regional communities.

PHOTO CREDIT: COURTESY ANDI LUCAS



Only five photographs of Ned Kelly exist, including this portrait taken on 10 November 1880 at Melbourne Gaol – the day before his execution.

PHOTO CREDIT: CHARLES NETTLETON, COURTESY STATE LIBRARY VICTORIA

MEET THE REAL NED KELLY

STORY BY **TIM THE YOWIE MAN**

We Aussies love our bad-boy antiheroes, and the armour-clad bearded bushranger Ned Kelly is the most notorious of them all.

WHO'S THE MOST famous Australian of all time? That's the first question I ask my audience on the after-dark tours I host at the National Film and Sound Archive of Australia (NFSA) in Canberra.

Almost without exception, and with little or no nudging, the same response is inevitably hollered from the bleachers. And, surprisingly for a country obsessed with chasing balls and swimming up and down a black line in a pool, the answer is not a sportsperson.

It's Ned Kelly.

And that's my cue to press play on the world's first feature film, *The Story of the Kelly Gang*, which first screened in Melbourne on Boxing Day 1906. Shortly after, in early 1907 after watching the film, five children in country Victoria held up a group of schoolchildren at gunpoint. Authorities acted swiftly and banned the film in towns with strong Kelly connections such as Benalla and Wangaratta. Nonetheless, the film was a box-office hit, enthralling viewers for 10 years and further entrenching Kelly's exploits into our national psyche.

Whether you view him as a cop killer or champion of the downtrodden, Kelly has infiltrated just about every corner of Australian life. You can hardly venture anywhere in our country without being reminded of the bushy-bearded bushranger. The letterbox at the end of my street is bluntly hacked into the shape of his trademark armour, and the overworked barista at my local cafe proudly sports Kelly's famed, albeit unsubstantiated, last words – 'Such is life' – inked on his milk-frothing arm. And I don't live within cooee of Kelly country.

So, what exactly did Kelly – born in country Victoria to Irish parents, his father a former convict, and just 25 years old at the time of his execution – do to deserve such notoriety? It's something a long list of commentators, criminologists and historians have grappled with, none more so than self-confessed Kelly enthusiast Craig Cormick. Craig edited the 2014 tell-all book *Ned Kelly Under the Microscope: Solving the forensic mystery of Ned Kelly's remains*, arguably the most comprehensive attempt to separate fact from fiction about Kelly's life and death.

"Many countries have stories of folk heroes," Craig explains. "European Australia didn't really have one until Ned came along, and he fits the mould perfectly – he's both a folk hero and an antihero all rolled up in one."

When I prod Kelly devotees during my exposé at the NFSA to divulge what makes him so (in)famous, most surprisingly answer with a question: "Oh, didn't he take from the rich to give to the poor like Robin Hood?"

"The Robin Hood argument has some merit," Craig says, "at least for rural poor people near Jerilderie on the Victoria–NSW border area."

After robbing the town's bank in 1879, Kelly set fire to mortgage documents and other securities the bank held as collateral for loans, daringly declaring: "The bloody banks are crushing the life's blood out of the poor, struggling man!"

But Craig is quick to pour more than a trickle of cold water on the Robin Hood comparison. "We easily overlook the darker side of his reality – that Kelly took part in killing three policemen, or that he planned to derail a police train in what today would be termed an act of terrorism," he says. "Your ►

ON THE KELLY TRAIL

Glenrowan: The Holy Grail for Ned Kelly enthusiasts who swarm here to see the location of the last stand and a proliferation of Kelly-themed souvenir shops, restaurants and exhibitions.

Benalla: The Benalla Costume and Kelly Museum holds the gruesome, blood-stained, 7ft-long green sash Kelly was wearing under his armour when captured. It was a gift from the parents of a 7-year-old boy that 10-year-old Kelly rescued from drowning at Avenel in the 1860s.

Beechworth: In 1879, in a desperate bid to limit support for the Kelly Gang, about 20 Ned Kelly sympathisers were detained at the town's historic gaol – some for several months. Fearing the Kelly Gang might try to free them, the wooden gates were also replaced by iron ones.

Jerilderie: While robbing a bank here in February 1879, the Kelly Gang burned mortgage documents and other securities held by the bank as collateral for loans – an act Kelly claimed was intended to relieve struggling farmers of their debts. After robbing the bank, a 56-page letter, narrated by Kelly and written by fellow gang member Joe Byrne, was handed to authorities. In the letter, Ned explained the political and personal reasons behind his actions, complained about the conditions of the poor in Victoria, and cited cases of alleged police corruption.

Stringybark Creek Reserve: Kelly's criminal status was raised from petty horse thief to Australia's most wanted outlaw after ambushing police in 1878, resulting in the deaths of three policemen. Whether Kelly was shooting in self-defence, or had set a trap for the officers and gunned them down in cold blood, is still debated.

Old Melbourne Gaol: On 11 November 1880, Kelly was hanged and buried at the back of the gaol.

State Library Victoria: Ned Kelly's armour is currently on display here. Ironically, it's in the reading room named after Sir Redmond Barry – the very man who sent him to the gallows.

trajectory in history is determined [by] how it plays out, and Kelly is remembered by many for standing up, against the odds, against the police troopers at his last stand."

However, the mythology that has elevated Kelly to antihero status extends well beyond comparisons to a fictional character prancing around in green tights and that bold last stand at Glenrowan that spawned the national idiom of bravery: 'as game as Ned Kelly'. It's only when you steal a peek behind his tin mask, interrogate his defiant last words, delve into an alleged curse and probe the reverential treatment of his skull, that the real Ned Kelly unravels.

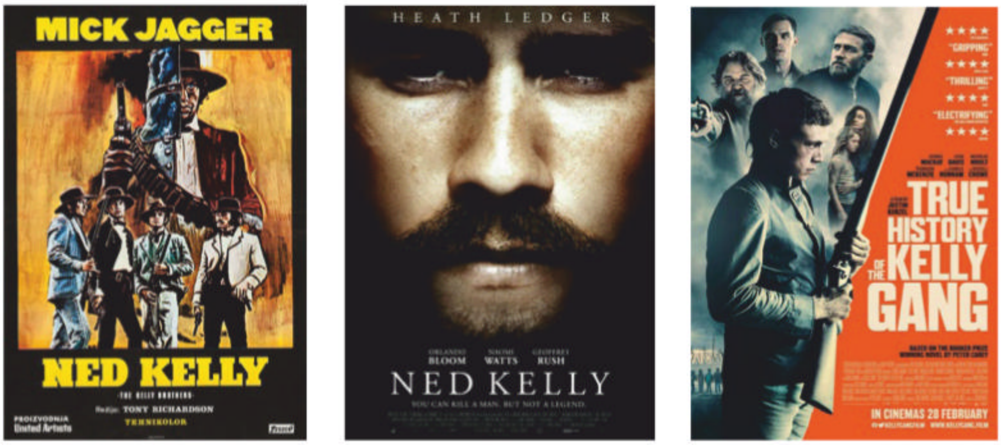
CAN YOU IMAGINE Ned Kelly without his trademark armour? Or Sidney Nolan's celebrated series of paintings without Ned in that helmet? Despite its imposing appearance, the armour, crudely crafted from farm ploughs, was much more than a physical defence. It was also a compelling symbol of the Kelly Gang's defiance and resistance against the established order.

Craig doesn't underestimate the figurative power of the helmet. "It's one thing that really sets Ned apart from the other bushrangers. Over time, without physically wearing it, people tend to fill that mask with their own wishes or desires," he says. "For example, I was up at a rodeo in north Queensland, and the guy next to me had a big Ned Kelly tattoo on his arm. I spoke to him about Glenrowan and, remarkably, he'd never heard of the place. For this guy, Ned and his mask represented a step away from the mainstream, a streak of antihero and disregard for authority."

But the armour was also Ned's Achilles heel. Taking on more than 30 police in the final showdown at Glenrowan while donned in iron plates weighing more than 40kg, and with his lower legs exposed, was always going to end badly. It slowed Kelly down, and although no bullets penetrated his armour, he suffered extensive bruising and lacerations from their impact. He was finally felled by a barrage of lead shot fired at those unprotected legs.

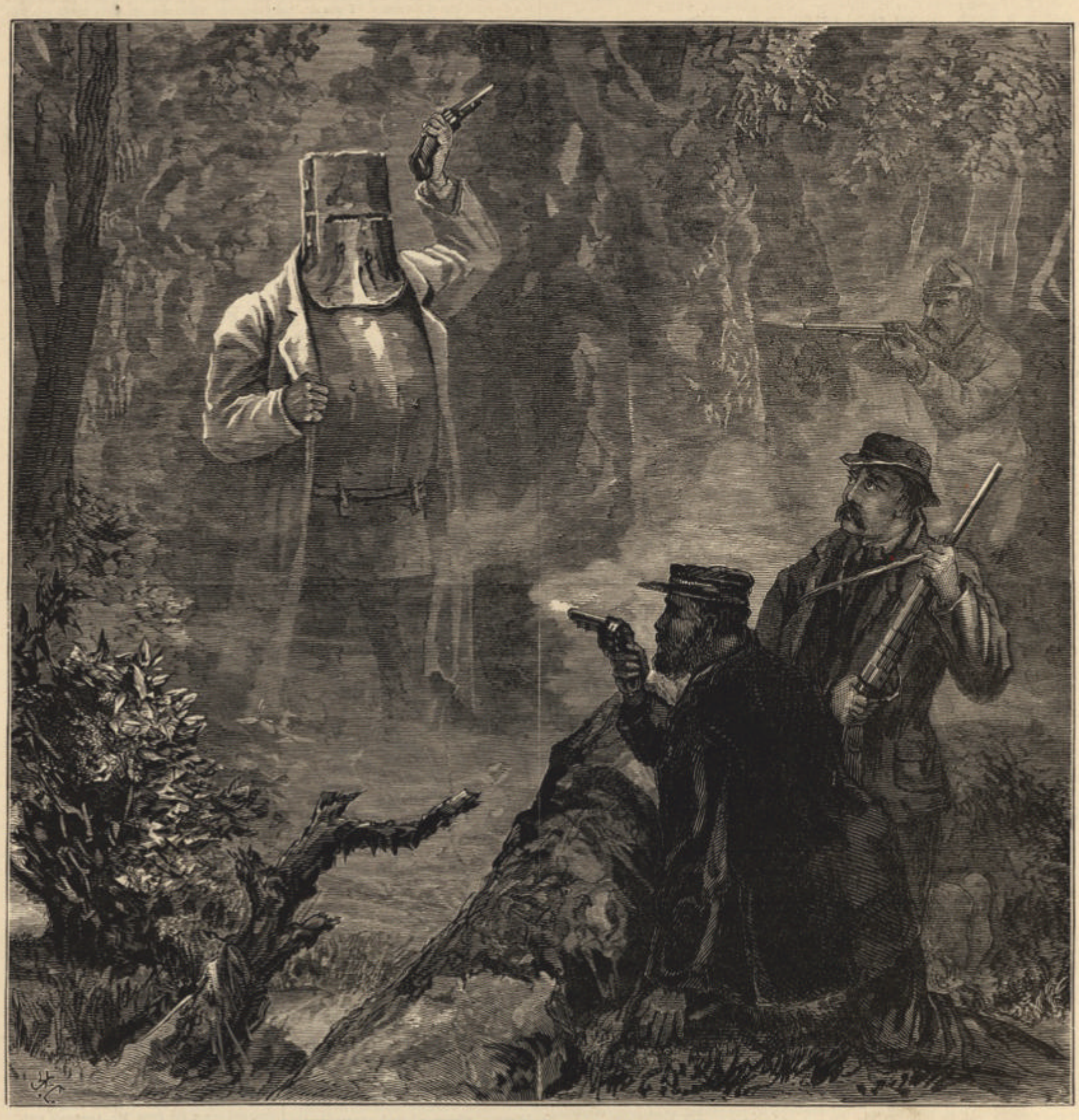
Contrary to popular belief, we can't be sure of Kelly's last words as he waited for the hangman to drop the gallows at 10am on 11 November 1880 at (Old) Melbourne Gaol.

The plethora of media reports that followed Kelly's hanging are conflicting, to say the least. While *The Goulburn Herald*



At least a dozen films have been inspired by Ned Kelly and his exploits, including (from left) a 1970 biopic starring Mick Jagger; a 2003 release starring Heath Ledger; and the 2019 *True History of the Kelly Gang*, starring George MacKay in the role of Ned.

PHOTO CREDIT: ALAMY



A STRANGE APPARITION—NED KELLY'S FIGHT AND CAPTURE.

"His head, chest and sides were all protected with heavy plates of quarter-inch iron. Many shots hit him, yet he always recovered himself, and tapping his breast laughed derisively, as he coolly returned their fire. It appeared as if he were a fiend with a charmed life."—*The Age* report.

This wood engraving by James Waltham Curtis, entitled *A Strange Apparition – Ned Kelly's Fight and Capture*, depicts the bushranger under fire from police during his infamous 'last stand'.

PHOTO CREDIT: COURTESY STATE LIBRARY VICTORIA

and Chronicle reported Kelly uttering those three now-famous words, a reporter for *The Argus* who witnessed the hanging from below the platform reported that Kelly's last words were, "Ah well, I suppose it has come to this." A reporter for *The Sydney Morning Herald* heard something similar: "Ah well! It's come to this at last!"

Unfortunately, the records of Henry White – the gaol warder who was standing much closer to Kelly than the eager throng of voyeuristic journalists – are unable to shed any light on the conundrum. He apparently scrawled in his diary that, just as the rope was adjusted around Kelly's neck, the condemned outlaw "opened his mouth and mumbled something [he] couldn't hear".

"If different people, including journalists, heard and reported different words, then we seriously need to question whether 'Such is life' really were his last words," Craig says.

After meticulously analysing the reportage of the day, historian Dr Stuart Dawson goes one step further. "The image of Kelly standing tall and defiant, saying 'Such is life' as the rope was placed around his neck, is nothing short of a romanticised myth," he declared in his no-holds-barred paper published in Monash University's *Eras Journal*. "It's pure fiction…in fact, Kelly came to an ignominious, mumbling end on the scaffold, a far cry from popular legend."

Ouch. That'll send shivers up the spine of even the most rusted-on Kelly enthusiast.

IF KELLY COULD come back and haunt anyone, Sir Redmond Barry – the judge who presided over his trial and ultimately sentenced him to death – would be top of his list.

But Kelly held a serious grudge against Barry long before he was marched to the gallows. Twelve years earlier, Barry had condemned Kelly's uncle, Jim Kelly, to death – later commuted to 15 years in prison – for arson and attempted murder.

In 1878 Barry sentenced Kelly's mother, Ellen, to three years in prison for the attempted murder of Constable Alexander Fitzpatrick. Kelly always asserted the trooper fabricated the story, and many commentators supported these claims – especially after the disgraced constable was later sacked from the police force for 'general misconduct'. Ellen was still serving her sentence at Melbourne Gaol when her son was executed and reportedly heard his execution from within the walls of her cell. And for the record, no, she didn't hear him say 'Such is life'. ►

Just to rub salt in his wounds, it was also Barry who shrewdly moved Kelly's trial from his home turf at Beechworth to faraway Melbourne because of fears that his sympathisers would interfere with a trial.

Despite the well-publicised animosity between the two men, just after the judge handed down Kelly's death sentence – followed by that customary legal benediction, 'May God have mercy on your soul' – Kelly created an uproar in the courtroom when he responded, "I will go a little further than that. I will see you there where I go." In saying this, some believed Kelly was placing a curse on his nemesis.

Kelly's words took on an even more sinister meaning when, less than two weeks after his lifeless body was cut from the scaffold, Barry joined him six feet under. Of course, there's no scientific basis for a curse, and Barry's death certificate stated he succumbed to a combination of pneumonia and blood poisoning from an untreated carbuncle – but that hasn't stopped the so-called curse becoming engrained in Kelly folklore.

On the eve of his execution, Kelly wrote to the governor of the gaol pleading for him "to grant permission for my friends to have my body so they might bury it in consecrated ground". His request was rejected; after Kelly's lifeless body was removed from the gallows, his still-warm corpse was openly picked over (that's putting it nicely) by medical students. He was later buried in the labour yard at Melbourne Gaol alongside dozens of previous prisoners who'd suffered the same fate. But it wouldn't be his final resting spot. Far from it.

In 1929, when the gaol was decommissioned, the bodies of the executed prisoners, including Kelly's, were exhumed and reinterred at Pentridge Prison. When word spread that authorities were about to dig up the bones of the notorious bushranger, a crowd gathered. Some were there for much more than a sticky beak, and in the chaos, graves were looted.

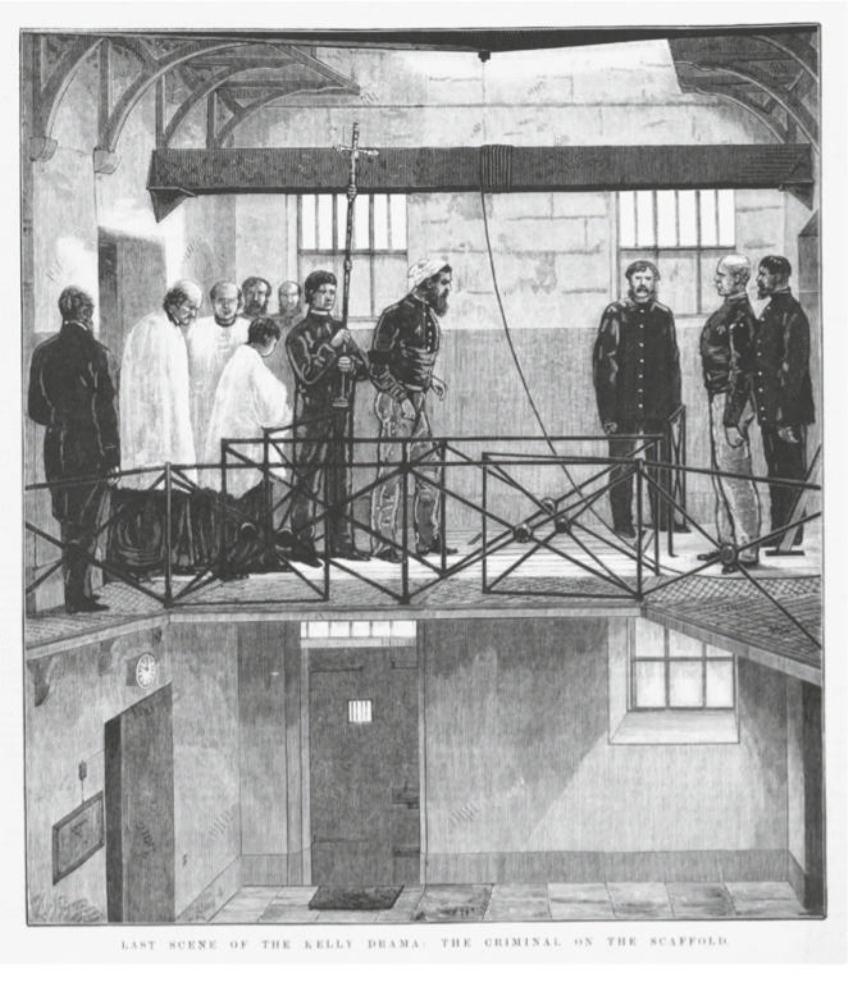
Fearing the holy grail of Kelly's skeleton would be filched, Henry Lee, one of the contractors involved in the exhumation, grabbed the skull for safekeeping. He then kept it on his bedside table (really!) for a couple of nights while he mulled over what to do with it, before eventually handing it over to a state official. The skull's whereabouts remained a mystery until the early 1930s, when it reappeared as a prized possession in the collection of prominent Victorian comparative anatomist Colin MacKenzie.

MacKenzie was the driving force and first director of the newly created Australian Institute of Anatomy [see Traces, AG 177] in Canberra – now home to the NFSA, which ironically houses dozens of films about Ned, including the aforementioned world's first feature film. Although MacKenzie collected heads for science, he thought visitors – no doubt propelled by a fascination with our brutal colonial past – would be captivated by the national relic in a similar way to pilgrims being drawn to the heads of martyrs in churches in Europe. And he was right; it drew the masses.

However, subsequent directors of the institute saw Kelly more as a convicted criminal than a knight in shining armour and removed the skull from display, consigning it to a box squirrelled away in the bowels of the building. It was only rediscovered again during the clean-out of a basement safe just before Christmas in 1952.

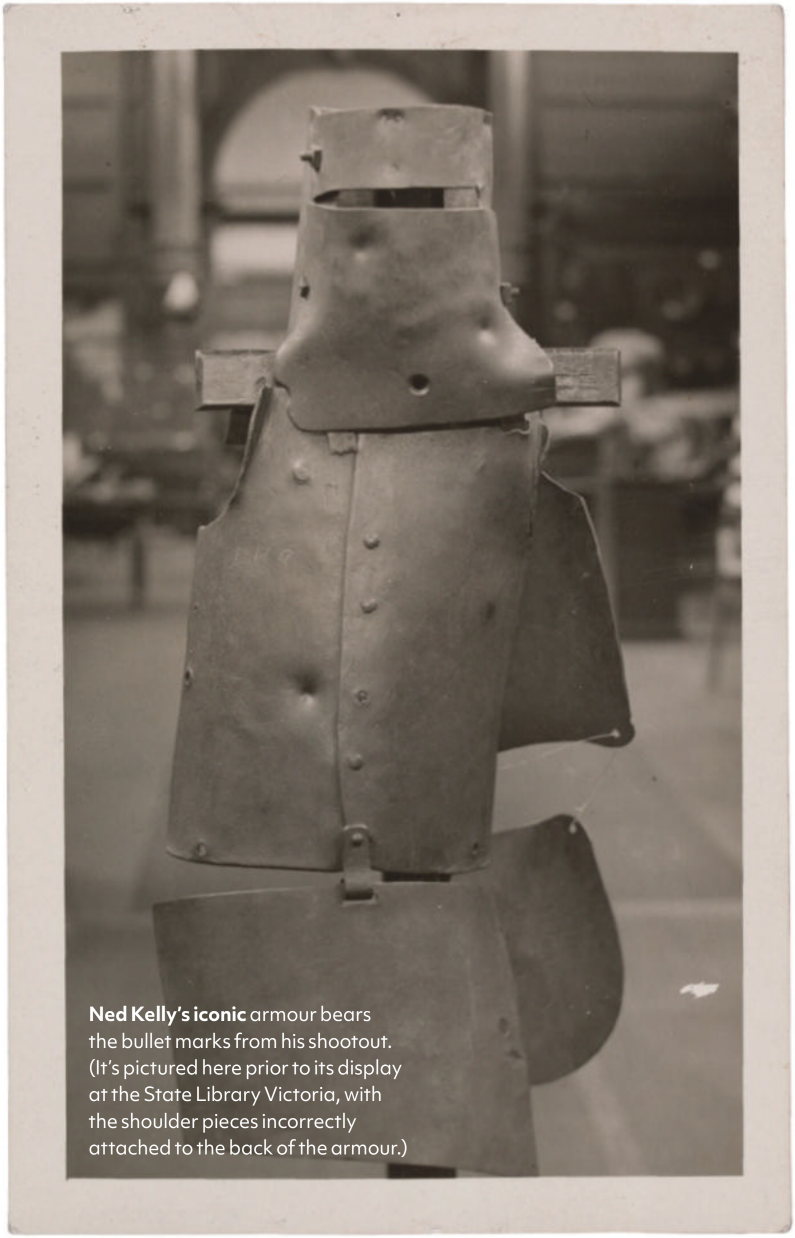
Less than 20 years later, the skull was escorted back to Melbourne as the centrepiece of a new exhibition at Old Melbourne Gaol museum. Someone ought to have signed Ned's Head up to a frequent-flyer scheme, because just five years later it was on the move again, brazenly stolen from the exhibition in broad daylight.

Soon after, recluse Tom Baxter – who was of the belief the head shouldn't suffer the indignity of being on public display – admitted he was in possession of the skull and had hidden it in a Tupperware container in the hollow of a log in the Kimberley.


LAST SCENE OF THE KELLY DRAMA: THE CRIMINAL ON THE SCAFFOLD.

This wood engraving from the early 1950s depicts the moments before Ned Kelly's execution. His final words – often purported to be "Such is life" – are the subject of contention.

PHOTO CREDIT: COURTESY STATE LIBRARY VICTORIA



Ned Kelly's iconic armour bears the bullet marks from his shootout. (It's pictured here prior to its display at the State Library Victoria, with the shoulder pieces incorrectly attached to the back of the armour.)

Out of sight, out of mind. Authorities oddly resisted pursuing the matter further (in the 1970s there was no way of proving it was Kelly's skull anyway) until 2009, when the Victorian Institute of Forensic Medicine (VIFM) announced an audacious plan to identify the remains of the prisoners – including those of Kelly – who had been exhumed at Old Melbourne Gaol and reinterred in a mass grave at Pentridge Prison back in 1929.

Baxter was convinced to return the skull, in the hope Ned's Head could be reunited with his skeletal remains and given "a proper burial for a figure...[who] looms so large in our history and was persecuted by authorities".

Flood, searing heat and age had all taken their toll on the relic; Baxter used araldite to patch up parts of the skull. "He never admitted to taking it, only that he was in possession of it," says Fiona Leahy, a medico-legal advisor who was part of the VIFM's multidisciplinary team comprising an eclectic mix of anthropologists, odontologists, pathologists, archaeologists, and just about every other 'ologist' you can think of. "So, we never really pressed him on it. We were just grateful that he brought it in."

> **"While he had sympathisers, we also know that Kelly was very unpopular in many circles, especially those dealing with the law."**

The sense of occasion hadn't made Baxter treat the skull with any extra care. Rather than taking it in his carry-on and cradling it onboard the flight across the Nullarbor, he popped it in his checked-in luggage.

Subsequent DNA testing proved a headless skeleton exhumed at Pentridge was indeed Kelly's. But in a bizarre twist – despite confirmation it was the same one displayed at the Institute of Anatomy in 1934 and later stolen from Old Melbourne Gaol in 1978 – the 'Baxter Skull' turned out not to have belonged to Kelly. What a revelation!

"The souvenir hunters likely targeted the wrong grave back in 1929, which means the skull could belong to just about anyone executed and buried at the gaol – although it's most likely to be from a prisoner buried close to Kelly's execution date of 1880," says Jeremy Smith, principal archaeologist with Heritage Victoria.

So, where's Ned's Head now? There are more theories than there are 'Such is life' stencils in tattoo parlours around the nation. It's a classic Australian whodunnit.

Craig has heard them all. "While he had sympathisers, we also know that Kelly was very unpopular in many circles, especially those dealing with the law," he says. "Someone may have decided, 'We don't want him turned into a martyr, so we'll get rid of it.'"

Then there's this tantalising lead. "After the book was published, I had a priest tell me that he has it on good authority that Ned's Head was buried by another priest, but he was sworn to secrecy," Craig says.

If Ned's Head, wherever it's currently hiding, is reunited with the rest of his skeleton – which in 2013 was buried in an unmarked plot near his mother's grave in country Victoria – it would provide closure.

But its missing status also adds another layer of intrigue to the legend of Ned Kelly that, whether you like it or not, continues to grow 145 years after his death. ■

'Boxes & Burial Bones', an exhibition featuring objects unearthed during Heritage Victoria's landmark 2009 excavation of the mass grave at Pentridge, which included Ned Kelly's bones, is at Pentridge Prison until 31 August 2025.

PHOTO CREDIT: COURTESY STATE LIBRARY VICTORIA

TAKING BACK THE POWER

STORY AND PHOTOGRAPHY BY **RACHEL MOUNSEY**

A scheme bringing solar electricity to remote communities promises to improve the lives of some of Australia's most disadvantaged people.

The Marlinja community celebrates the launch of its own solar farm and battery.

Tennant Creek's Indigenous population is living day-to-day in deeply entrenched energy poverty.

THE CONCRETE IS hot beneath Nicole Frank's feet as she pushes her newborn strapped into a pram up the Stuart Highway, in Tennant Creek, almost 1000km south of Darwin. Glowing red numbers on the digital thermometer on the town clock read 39°C. The time is 10.15am.

Just 20 minutes earlier Nicole's electricity cut out, so she's off to top up her power card. She pushes the pram through the plastic doorway streamers of the store where she can reload the card and then heads home, hoping $60 worth of credit will get her through the next few days.

A couple of blocks away on Skipper Street, an elderly woman in a wheelchair is doting over her grandchild. She passes the baby back to its mother before reaching into her pocket and taking out a $50 note. "Food or electricity?" the two women ask each other. They decide on electricity.

On the outskirts of town, at Norman Frank Jupurrurla's house, a TV news crew has turned up. They follow him around, filming while he proudly flicks switches, turning on lights, fans and air con all at once. He swings open the fridge door and beams as he explains how good it is now that his medicines won't spoil. He flips up the cover on the meter box. "Look," he says pointing to the digital numbers, "see how much credit I've got!"

He picks up a handful of old power cards strewn across the bottom of the meter box and fans them in his hands like a deck of cards for the camera, then explains how they work. "They're like a mobile phone," he says. "You pay credit as you go. When you run out of credit, the power cuts off. It just goes out."

Norm is the first person living in Indigenous social housing in the Northern Territory to have solar panels. They sit on his roof shining brilliantly like prized diamonds. "How'd you get that solar up there?" everybody asks. "A whole lot of shaking the bush," he tells them.

AUSTRALIA IS A leader in the uptake of solar power. One in three Aussie households is connected to rooftop solar, either through self-funding or partly funded through federal and state government initiatives such as the Small-scale Renewable Energy Scheme.

The solar boom is particularly prevalent in the towns and cities along the edges of the continent, where most people own their own homes and can invest in, and decide on, their own infrastructure. But it's a different story in the interior, especially in remote and regional First Nations communities where most residents live in government-owned public housing. Despite being in one of the world's most ideal solar locations with more than 300 days of sunny skies a year, Tennant Creek's Indigenous population is living day-to-day in deeply entrenched energy poverty.

So, Norm simply asked: "If everybody else has got that solar, why can't us blackfellas in the desert have it too?"

When his question didn't get him anywhere, he decided to – as he puts it – 'shake the bush'. That's when he teamed up with Original Power, a First Nations-led not-for-profit focused on overcoming the structural barriers that prevent First Nations communities from participating in, and benefiting from, the transition to clean energy.

Original Power selected Norm's household to be the demonstration house in a trial project, which focused on combining existing prepayment meters with rooftop solar. If the trial is successful, it could prove pivotal in gaining access to renewable energy for Australia's 15,000 First Nations households that rely on prepaid power cards.

But putting solar onto the roof of Indigenous social housing had never been done before, and it was far from a straightforward process. It required a series of bureaucratic barriers to be overcome. Firstly, it challenged NT regulatory agencies, which argued that prepaid meters and rooftop solar couldn't coexist. Up until Norm's place, previous requests to the NT Government's Power and Water Corporation to connect rooftop solar from prepayment customers were shut down by an automatic 'no'.

Round two was with Norm's landlord, the NT Department of Housing, Local Government and Community Development, which was uncomfortable about allowing any new fixtures on the home. But after months of negotiations and building inspections to ensure the roof was capable of hosting solar panels, an agreement was eventually struck and the panels were installed – with a clause that Norm would remove the panels at his own cost at the end of his tenancy.

The next round was with PowerWater, the NT Government's power and water agency. Norm says a padlock placed over the smart meter's solar input was stopping the house from connecting to the grid. Because there wasn't a system in place for prepaid power customers to access rooftop solar, there were long delays while PowerWater and the energy retailer, Jacana, navigated and negotiated paperwork regarding energy exports and feed-in tariffs. Finally, during one of the hottest heatwaves on record, Norm was given the go-ahead for the connection. But the padlock remained. "So, you know what I did?" he asks before revealing his knockout punch. "I reached into my toolbox and got out my angle grinder."

"And the world didn't cave in," says Lauren Mellor, Original Power's Clean Energy Communities program director. "In fact, Norm's household completely resolved its energy challenges, going from an average of 24 disconnections in a year to zero and significantly reducing household energy costs. But you have to make sure you get every detail right. There are clauses to watch out for before signing off…otherwise it could be another year of setbacks."

I'm travelling with Lauren to Original Power's next big challenge: the remote community of Marlinja, more than 600km south of Darwin, where it's hoped it will be proven that solar and prepayment meters can work on a community scale. Lauren has been trying to get out here for months, but because of the biggest wet season on record since Cyclone Tracy hit in 1974, she has had to wait. After more than five years of planning, the Marlinja community is preparing to celebrate the launch of its own solar farm and battery – the first Indigenous community in Australia to achieve this. The solar farm will mean an end to costly diesel power and constant disconnections. For residents, it's literally a case of taking back the power by providing their own homes with electricity. ▶

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1
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Norman Frank Jupurrurla and his daughter (opposite) can now enjoy air-conditioned comfort at their Tennant Creek home.

"While the rest of Australia is racing to take up the benefits of renewable energy, First Nations energy customers and communities continue to face structural barriers to access," says Lauren Mellor (left), Original Power's Clean Energy Communities program director.

Solar panels are carried to be installed on a home in West Island, in the Gulf of Carpentaria, as part of an Original Power and Ngardara Cooperative project.

DAILY LIFE IN isolated remote communities like Marlinja can be extreme: the houses are not properly insulated, and there are often running-water issues that are compounded by isolation and lack of access to essential services. When the power goes out, life becomes even more extreme. It's when water has to be collected from the creek; it's when kids can't shower for school; it's when cooking has to be done outside; it's when fridges blow up; and it's when vital medicines spoil.

For Marlinja, collaborating with Lauren and Original Power since 2018 has quite literally meant light at the end of the tunnel. By 2021 they had fundraised enough money – $750,000 – to fit out all houses in Marlinja with rooftop solar.

But the NT Department of Territory Families, Housing and Communities, which owns the homes in the remote community, wouldn't approve rooftop solar on social housing. After a couple more years of surveys, feasibility studies and creative problem-solving, a new plan was hatched for a community solar farm that would charge a community battery and feed electricity into every house in Marlinja.

At the community hall, Chantelle Johns is preparing for the solar-farm launch, eagerly stringing up fairy lights and humming along to R&B, when suddenly the power goes out.

She takes a deep breath, thinking about last wet season when the creek was up and the power was out for so long – a whole month – that utility workers had to be ferried over to fix it.

"They said they couldn't get in because of the flooding," Chantelle recalls. "So we brought them across with our own boats, put them in our cars and drove them up here just so they could put it back on for us. Just so they could flick a switch."

Fortunately, that hasn't happened this time, and after about 10 minutes the lights come back on. Chantelle breathes a sigh of relief and gets on with the job again. Later in the afternoon, the red dirt road in between the community centre and the solar farm is lit up like a festival.

Mudburra Elder Raymond Dimakarri Dixon, who lives in Marlinja, becomes emotional when opening the proceedings to celebrate the installation of the solar farm and new battery. "Wangku is our word for sun," Raymond says. "From the moment you're introduced to Country, from the day that you're born, wangku is always there. That wangku is our light."

He's overcome with emotion – and for good reason. This facility means the future of his community. It means there will be no more driving 25km into town to top up costly power cards. It means more money for food and other essentials. And

Raymond Dimakarri Dixon relaxes at home the day after opening proceedings to celebrate the installation of the Marlinja solar farm and new battery.

All these energy-related developments will mean that people can remain at home on Country.

it means an end to disconnections, which translates into cool houses during record heat, fridges that will stay on, and food and essential medicines that won't spoil.

All these energy-related developments will mean that people can remain at home on Country.

IMPORTANT CEREMONIES HAVE always taken place at Marlinja. It would have taken about six hours for the mob from the eastern Arrernte community of Santa Teresa, 70km south-east of Alice Springs, to get here. They've come to learn about the solar grid.

Norm has travelled up from Tennant Creek, 265km south, invited as a special guest to the opening. He addresses the crowd, telling them he has a dream of seeing solar installed on every Indigenous rooftop in the NT.

"That sun," he says, pointing his finger to the sky, "he is our medicine. Clean energy – it's what our people need... It's been here all along. It is here, it is free, and no-one can take that away."

The next day, Raymond is sitting on his verandah feeling satisfied, thinking of how his parents would have been proud of everything Marlinja has achieved in the past few years; of how the community stood up against fracking on their lands, and how now they've installed the solar grid.

Looking over at nearby Newcastle Waters station on the other side of his fence, he's reminded of his family's long, unwavering involvement in historic events. It was on that same station – in 1952, before he was born – that his mother, Lady Dixon, and other domestics signed a petition demanding better living conditions, asking for toilets and showers. They were also desperately concerned that their family remained intact during assimilation times – the times of the vanishing – and demanded that their tribal group not be dispersed.

And then, when Raymond was aged 10, in 1966, his father, Pharlap Dixon, walked off the station in protest. He and the other Indigenous stockmen were fed up with working for only tea, sugar and flour. They wanted the same rights as everyone else.

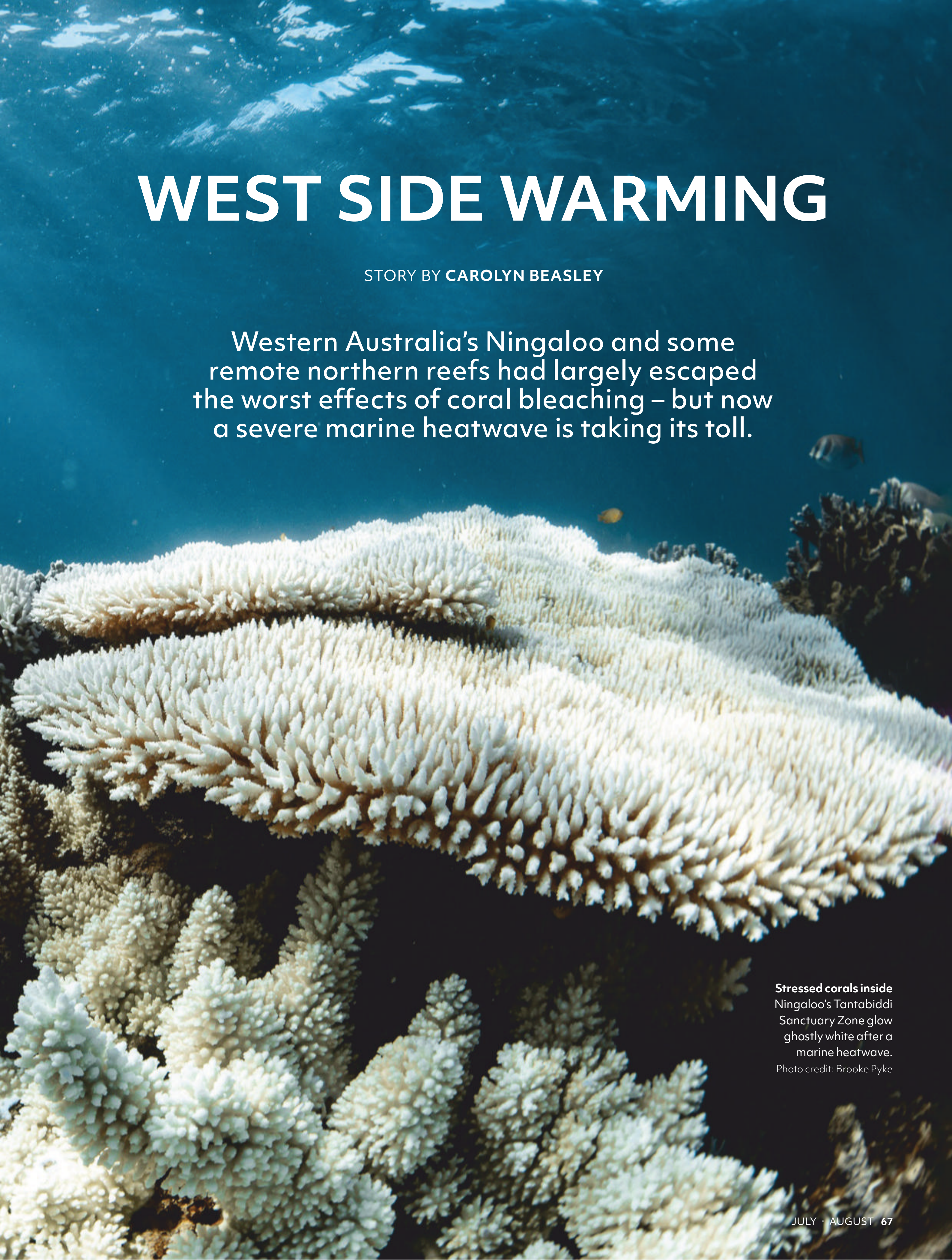
"It was a big movement, and it started here," Raymond says proudly. "It was before Wave Hill [the NT station where, in 1966, 200 Gurindji stockmen, domestic workers and their families took strike action]. And it was my father. He was a leader for his family and his tribe. He made that decision.

"My family were always standing up for their rights. That was their legacy. And that legacy we carry on today." ■

WEST SIDE WARMING

STORY BY **CAROLYN BEASLEY**

Western Australia's Ningaloo and some remote northern reefs had largely escaped the worst effects of coral bleaching – but now a severe marine heatwave is taking its toll.



Stressed corals inside Ningaloo's Tantabiddi Sanctuary Zone glow ghostly white after a marine heatwave.

Photo credit: Brooke Pyke

WE'VE BECOME ALL too familiar with mass coral bleaching events in the Great Barrier Reef along Australia's east coast, but the continent's other great coral reef, Western Australia's Ningaloo, has been mostly spared. Until now.

For many West Aussies – me included – Ningaloo Reef is a cherished part of their identity. Aside from being famous for whale sharks, the reef is part of the Baiyungu, Yinigurdira and Thalanyji peoples' traditional land and sea country, and also features on the UNESCO World Heritage List.

For Exmouth resident Brooke Pyke, Ningaloo is a passion. Brooke works as a whale shark tour photographer, and in her spare time she freedives with her camera. In February, Brooke took to social media to document an unfolding disaster: the mass bleaching of Ningaloo. "I knew that if I could share photos, it would hopefully get into the forefront of everyone's minds, and especially get into the news with our upcoming election at the time," Brooke says.

Brooke's images had their intended effect and shocked the public. Seeing the photos felt like a punch in the stomach; coral colonies large and small were ghostly white, while others were fluorescing bright colours in their dying days.

CSIRO's Ningaloo Outlook shallow reefs team prepares to survey coral on the reef slope at northern Ningaloo.

RESEARCH
CSIRO

Brooke returns to her favourite corals almost daily, and as she explains the progression, she chokes back tears. "Corals that were still alive, but in a stressed, bleached state, they're now covered in algae and have already perished, including some of the huge *Porites* corals that we have here," she says. "It's like losing your best friend, really."

NINGALOO REEF HAS not suffered a significant bleaching since 2011–13. When compared with the Great Barrier Reef, there are a number of threats that aren't present in WA. These include major rivers that transport pollutants, population pressures, and plagues of the coral-eating crown-of-thorns starfish (*Acanthaster planci*). But overwhelmingly, climate change is the main threat to coral reefs worldwide, specifically marine heatwaves – and Ningaloo certainly isn't immune to those. Rising ocean temperatures cause coral bleaching and, in severe cases, coral death.

Many research groups study Ningaloo and WA's other coral reefs, including CSIRO, the Australian Institute of Marine Science (AIMS), the WA Department of Biodiversity, Conservation and Attractions (DBCA), and several universities. They collaborate to form the WA Coral Bleaching Group, sharing knowledge and resources.

Dr Damian Thomson is a marine ecologist for CSIRO, and the leader of a long-term ecological study named Ningaloo Outlook. When I speak to Damian, he's at Ningaloo conducting reef surveys of 80 sites between one and 15 metres deep. Damian has surveyed these sites since 2007, and more intensely since 2015.

"All of the sites have quite extensive coral bleaching, so the event is still very much underway," Damian says. "We're seeing around 60 to 90 per cent of the corals at each location have remained heavily bleached, and within that group probably 30 per cent have started to die."

The extent of the coral mortality will be quantified in a few months. Some corals may still recover, but Damian suspects many will die because of the intensity and duration of the bleaching event.

Ningaloo's previous bleaching event mostly affected branching corals inside the shallow lagoon. But this event sees severe bleaching all the way down to 20m, which has never been witnessed before. Like Brooke, Damian is shocked about the bleaching of *Porites* corals, which were generally considered less susceptible.

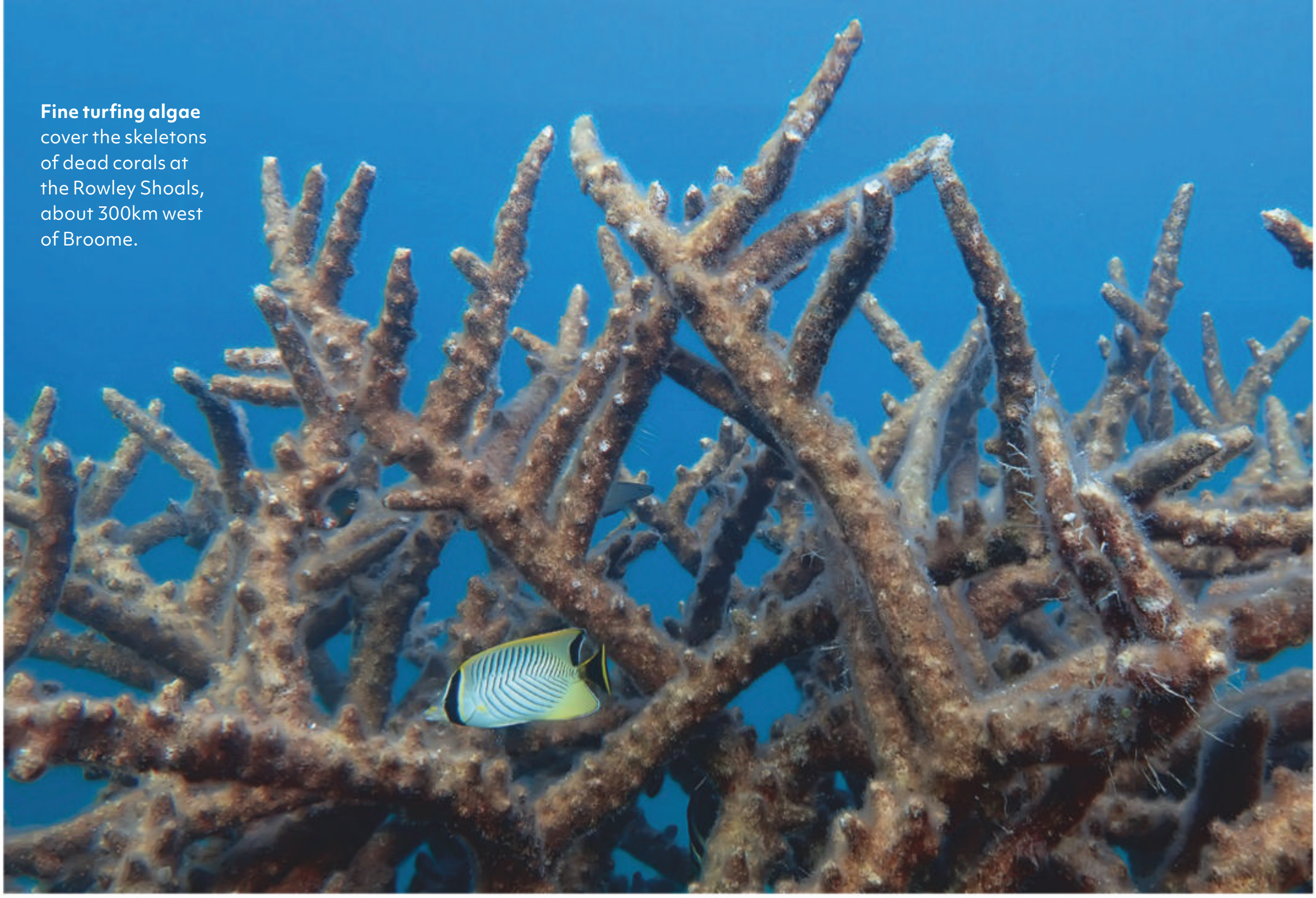
"That's indicative of the intensity of this event, because some of those massive corals would be over 500 years old," Damian says. Even tiny juvenile corals are bleaching this time. If they die too, recovery will be even slower.

Damian says his team only found one area where the damage was slightly less. "In the very north of our survey area, those sites are quite turbid," he explains, referring to suspended sediment in the water that may have reduced the overall stress. "The level of bleaching there is maybe about 10 or 20 per cent less than other sites."

It's not much of a positive, and this year's survey is taking an emotional toll.

"For the first time ever at Ningaloo, I'm questioning the long-term viability of the reef," Damian says. "A couple of

PHOTO CREDIT: VIOLETA JAHNEL BROSIG



Fine turfing algae cover the skeletons of dead corals at the Rowley Shoals, about 300km west of Broome.

PHOTO CREDIT: DR JAMES GILMOUR

> **"Nature is really resilient…but there are only so many bleaching events that nature can withstand."**

[people in] the team have quite young children, and they were lamenting the fact that their kids will probably never see Ningaloo in the same state that we have."

WHILE NINGALOO MAY be WA's tourism poster child, coral reefs also flank the Pilbara and the Kimberley, as well as occurring hundreds of kilometres offshore at the Rowley Shoals, plus the Scott and Ashmore reefs.

Dr James Gilmour is a reef ecologist with AIMS. He explains that northern oceanic reefs such as Scott and Ashmore have previously bleached due to extreme heat from El Niño events. Conversely, Ningaloo Reef further south has been affected by La Niña events.

But in the past five years or so, background temperatures in the ocean have increased, and bleaching is no longer limited to those extreme events. Normally, sea temperatures in north-western Australia peak in October and November and are then cooled by the cloud cover of the monsoon in about December. Temperatures normally rise again from February to April. This year, the monsoon only arrived in mid-February, meaning that corals were already bleaching by the end of 2024, with no respite over several months.

Temperatures recorded at Ningaloo, the Pilbara, the Rowley Shoals and the northern inshore Kimberley were by far the highest on record. "It's the first time we've seen this – a single event that has affected all of the coral reefs in WA," James says.

James and his team have just returned from the Rowley Shoals, about 300km west of Broome. Along with the inshore Kimberley reefs, this system has never severely bleached. James says both reef systems have been located in a 'lucky' geographic position, avoiding the worst of the El Niño and La Niña events – until now.

What James describes next causes me physical pain. Just a few years ago, I dived at the Rowley Shoals. It was a heaving mass of unfathomable biodiversity, from vibrant coral gardens to magnificent sailfish. "This time, we saw mass bleaching of the Rowley Shoals and evidence of mortality," James says. Well over three quarters of the corals surveyed at the Rowley Shoals are bleached and/or dying.

For James, who has spent his whole career studying coral reefs, this is devastating. "I was always heartened by the fact that WA reefs were far healthier than most around the world, and that there were still these places that hadn't bleached badly," he says. "But we have, as of right now, reached that point where they are also severely affected."

Given time, these reefs can regenerate. Scott Reef lost about 80 per cent of its corals in 1998 and within 10–15 years it had largely recovered. "We do know that nature is really resilient," James says. "But there are only so many bleaching events that nature can withstand."

He says if bleaching occurs repeatedly in a five-year period, the system will quickly degrade. We're not likely to lose all corals, because some species are less susceptible to bleaching than others. Some small adaptations to heat are happening, although not quickly enough.

Many of the corals most susceptible to bleaching and other disturbances are branching corals. These are also the corals ►

providing reef structure, habitat and food for many fish. If these die, there will be obvious implications for tourism, fisheries and other related industries. "There's no way that we'll be able to retain coral reefs as we know them in coming decades," James says.

The task now for scientists is to investigate management techniques that are useful in protecting these modified future reefs. "The fundamental cause, without a doubt, is carbon emissions and climate change globally," James says. "So that's the first and primary thing that we always talk about having to address."

Secondly, traditional management techniques may be useful. That includes reducing pollution, controlling fishing pressure, and controlling any predators such as crown-of-thorns starfish. In the WA context, most of these are already well-managed.

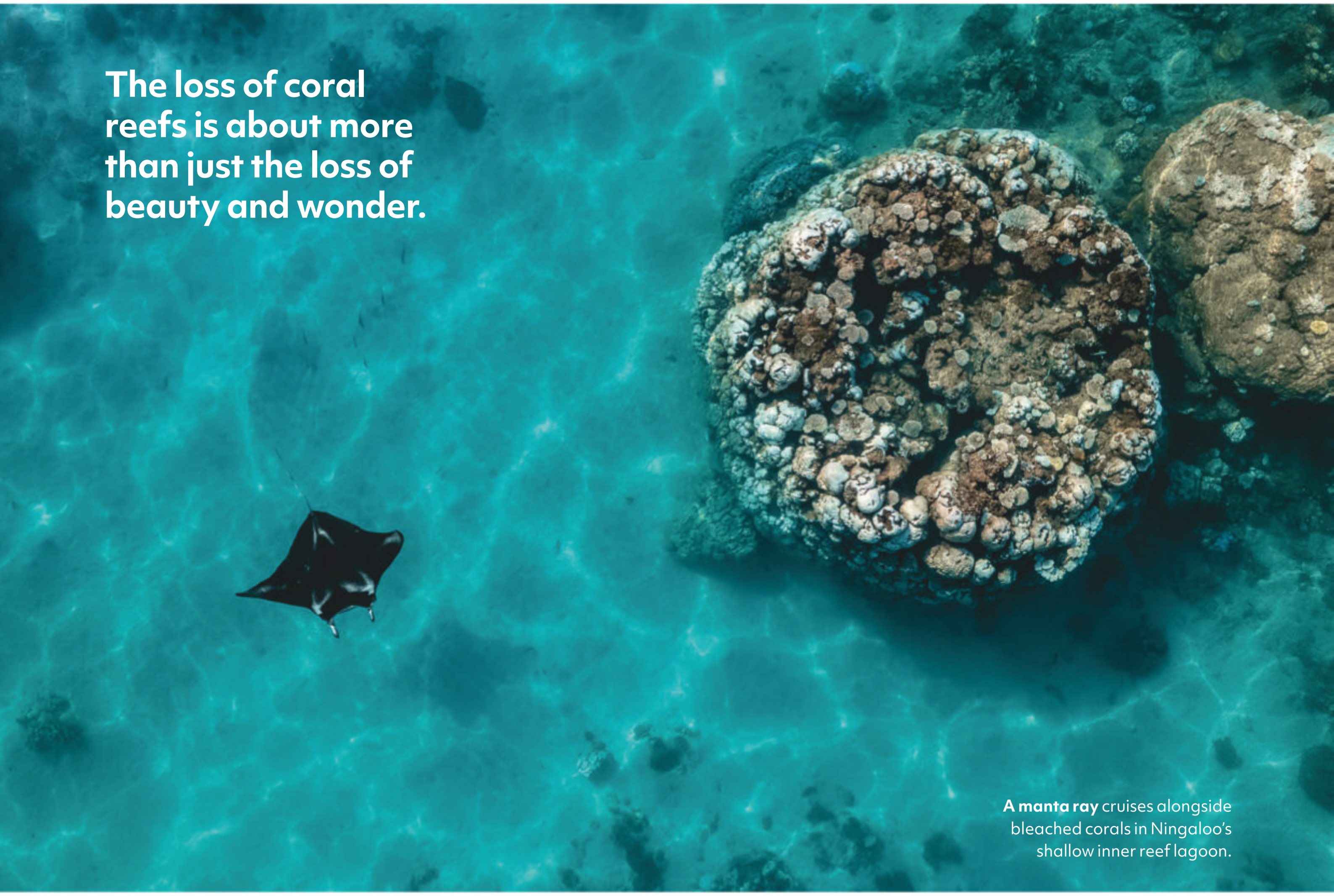
And thirdly, science can examine novel interventions to help reefs by producing corals that can survive warming oceans. James notes this is a significant challenge, because solutions must be scalable. Most of the intervention studies are happening in Queensland, from trying to cool the reef through enhanced cloud cover to finding heat-tolerant coral species and assisting recolonisation with live coral larvae. Some of the trials sound like science fiction, but everything is worth considering.

James says modelling our current trajectory is vitally important. "We've passed the point of having extensive, pristine, highly biodiverse environments, at least for a few hundred years," James says. "That's the trajectory we're on. But being able to nudge it in a slightly different direction, to where it's still a benefit to humanity, is really what we're talking about."

ASIDE FROM AFFECTING coral reefs, marine heatwaves have other, less obvious impacts. The Leeuwin Current, which flows north to south along the WA coastline, may bring the occasional manta ray south – to the delight of Perth swimmers. But this warm water can also devastate ecosystems.

DBCA conducts monitoring inside WA's marine parks, including Shark Bay. In the 2011 heatwave, Shark Bay lost about 1300sq.km of seagrasses, which underpin the ecosystem and are a significant carbon sink.

According to Dr Thomas Holmes, DBCA marine science program leader, other notable occurrences included significant



The loss of coral reefs is about more than just the loss of beauty and wonder.

A manta ray cruises alongside bleached corals in Ningaloo's shallow inner reef lagoon.

This vibrant, healthy coral – pictured before the recent bleaching event – is a sobering reminder of the missing colours at Ningaloo Reef.

Dr Damian Thomson collects data while diving in a lagoon at Ningaloo Reef.

PHOTO CREDITS, OPPOSITE PAGE: BROOKE PYKE; THIS PAGE, FROM LEFT: BROOKE PYKE; VIOLETA JAHNEL BROSIG

loss of kelps between Kalbarri and Jurien Bay, and a decline in coastal whitebait in the Perth area. It's too soon to know how the 2024–25 heatwave affected Shark Bay's seagrasses, but DBCA plans to monitor for changes over the next 12 months.

Warmer temperatures can also play havoc with commercial fisheries. Dr Simon de Lestang is the principal research scientist for WA's Department of Primary Industries and Regional Development. He says that during the 2011 heatwave some fisheries stocks were impacted almost immediately, including redthroat emperor (*Lethrinus miniatus*) and Spanish mackerel (*Scomberomorus commerson*), both of which moved south. Other impacts were delayed. "We didn't see too much happening initially, but about a month later, all the abalone were dead along the reef platforms around Greenough," he says.

For the valuable Western Rock Lobster fishery along WA's coast, there was also a lag in the effects. Usually, counts of juvenile lobsters, called *Puerulus*, inform predicted catch rates approximately four years in advance. But after the heatwave, this indicative measure became less accurate.

In the northern part of the fishery, where the temperature was most elevated, fewer adult lobsters were turning up than would be expected. Further south, more adult lobsters were caught than predicted. Simon says this is likely to do with the altered abundance of food for juveniles, such as marine snails, similar to the abalone.

Heatwaves also affect fisheries through range extensions, where species turn up in unusual places. "A few mud crabs were being caught in Augusta [in south-west WA] when they'd normally be found in Exmouth Gulf," Simon says. "Large numbers of blue swimmer crabs (*Portunus pelagicus*) turned up in south-coast estuaries, and commercial fishers were able to benefit from that."

For all of these scientists, marine heatwaves are becoming an increasingly distressing part of their work. In isolation, the degradation of any of these environments is devastating. But viewed collectively, the loss of them all is frightening.

James says he hopes people realise that the loss of coral reefs is about more than just the loss of beauty and wonder. "We've gone past the point of being sad about losing the most pristine, most beautiful parts of the world, into now starting to lose the natural resources on which we depend as humans," he says. "I hope this is the wake-up call and we all begin to realise that these things are a priority for existence."

As we non-scientists grapple with the implications of marine heatwaves, James urges us to get out and appreciate our reefs, which are still some of the best in the world. "Then just talk to everyone about it," James says. "Get the word out." That, he says, will promote appreciation of the reefs – both their value, and their beauty – and make Australians aware of the stark threats they face. ■

A powerful owl roosts along riparian vegetation on a creek in north-west Sydney. Photo credit: David Stowe

LET THERE BE NIGHT

STORY BY **MARNIE OGG**

Artificial light has illuminated and reshaped our world after dark – but at what cost?

IN THE SHADOWY fringes of Australia's cities, powerful owls roost in the urban canopy and hunt for prey over streets, parks and backyards. With piercing yellow eyes and a wingspan stretching more than 140cm, the powerful owl (*Ninox strenua*) is Australia's largest owl and a commanding mascot of the night, its recognisable *woo-hoo* call audible from afar.

Once confined to old-growth forests, where they hunted by the fleeting light of the full moon, powerful owls are now increasingly at home in the city environment. They've learned to exploit artificial light, hovering near streetlamps, garden spotlights and illuminated sports fields where prey such as possums and flying foxes find themselves exposed.

For those prey animals, darkness was once a trusted ally. But in a world of perpetual twilight, the balance has shifted. And while powerful owls may appear to be adapting and even thriving in urban areas, this newfound reliance on artificial light raises concerns about the long-term health of both predator and prey populations – and the broader consequences of disrupting the natural patterns that have shaped our world for millennia.

FOR 3.8 BILLION years, life on earth evolved under a dependable cadence of light and dark, governed by the rising and setting of the sun, the phases of the moon and the cycle of the seasons. These patterns varied across latitudes, from the equal split of day and night at the equator to the dramatic light extremes of the polar regions. Yet life adapted seamlessly, and ecosystems flourished. The key element was consistency. Darkness, like daylight, was predictable.

That all changed just 200 years ago with the invention of electric light. What began as a scientific breakthrough soon reshaped the human experience of night-time.

Often hailed as a modern miracle, the transition from early arc lamps to Edison's incandescent bulbs – and now to high-intensity LEDs and smart lighting systems – marks one of the most dramatic technological shifts in human history. Electric light brought convenience, productivity and perceived safety after sunset. It also reshaped architectural design by freeing buildings from daylight constraints, allowing skyscrapers to shoot up and reshape our cities.

But over time, artificial light has become excessive and inescapable. In just two centuries, we've lit up our planet so extensively that the dark side of earth now radiates from space. What might seem like a triumph of civilisation – cities illuminated in satellite images – has also become a glaring symbol of 'light pollution'.

The widespread adoption of energy-efficient LEDs has made bright lighting more affordable, but it has also made it easier to flood the environment with light, often without considering the biological or ecological costs. Increasingly popular large-scale lighting events and installations such as Vivid Sydney and Field of Light – where light is celebrated as spectacle – draw large crowds but equally reflect a growing cultural disconnect from natural darkness.

But natural darkness is a vital environmental component. Life on earth evolved in harmony with the cycle of day and night, leading to three broad behavioural patterns among its creatures: diurnal species are active during the day, nocturnal species thrive at night, and crepuscular species are most active at dawn and dusk.

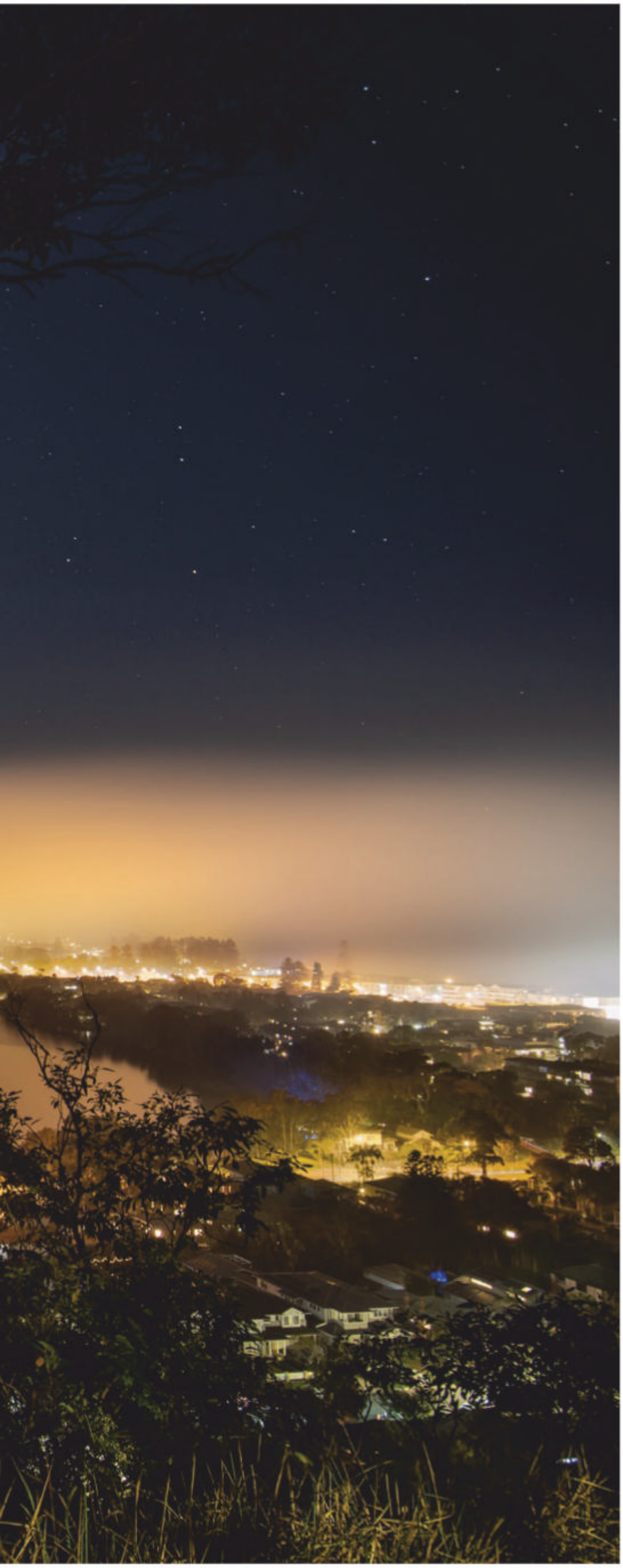
Humans are naturally diurnal. Our circadian rhythms, hormone production and sleep cycles are all aligned with the rising and setting of the sun. But artificial light, especially the blue-rich glow of modern LEDs, disrupts this delicate rhythm. While LEDs are celebrated for their energy efficiency and long life, they often emit high levels of blue light, particularly those used in streetlights and household fixtures.

This blue light closely mimics the midday sun. And while our eyes may not notice the difference, our bodies sure do. Exposure in the evening confuses our internal clocks, suppresses melatonin and disrupts the hormonal signals that prepare us for sleep. Even brief exposure can delay sleep and reduce its quality. Over time, chronic circadian disruption has been linked to sleep disorders, mood changes, metabolic issues and increased risk of chronic illness such as diabetes, Parkinson's disease and cancers.

Though LED technology is evolving – with warmer, amber-toned options now available – many homes, streets and public spaces are still bathed in harsh, daytime-like light well into the night. This lighting triggers our bodies to wake up when really they're crying out for darkness.

MOST AUSTRALIAN MAMMALS are active at night, having evolved to avoid the harsh daytime heat. Creatures such as the sugar glider, bilby and greater glider depend on the cover of darkness for foraging, navigation and protection. Crepuscular animals such as kangaroos and wallabies are most active in the dim light of dawn and dusk, while many bird and reptile species are strictly diurnal, relying on daylight to regulate temperature and behaviour. Disruptions to natural light cycles – think streetlights, sports fields and poorly designed urban lighting – can interfere with these patterns, affecting feeding, breeding, migration and survival. ►

A low-lying haze conceals twinkling stars above Lake Narrabeen and Turimetta Head on Sydney's Northern Beaches. Photo credit: Ed Hurst



Australia is uniquely positioned to lead in light-pollution management.

High in the Australian Alps, the Bogong moth's (*Agrotis infusa*) ancient migration is being thrown off course – not by predators or weather, but by the glow of artificial city lights. Drawn away from their alpine breeding grounds, fewer moths are making the journey, leading to population declines and threatening animals such as the endangered mountain pygmy-possum (*Burramys parvus*) that depend on them for food.

In Western Australia, Tammar wallabies (*Notamacropus eugenii*) near a naval base are also feeling the effects of night-time lighting. Researchers found that wallabies living under the glow of artificial light were giving birth a month later than those in naturally dark bushland nearby – an unsettling shift in their breeding cycle.

Even the fat-tailed dunnart (*Sminthopsis crassicaudata*), a tiny marsupial insectivore, has shown signs of disruption, says Dr Alicia Dimovski, a postdoctoral research associate in the Wildlife Conservation and Reproductive Endocrinology Lab at La Trobe University. "Studies reveal that both white and so-called 'wildlife-friendly' amber LED lights altered the dunnarts' activity levels, metabolism and body condition, and triggered breeding at unusual times," Alicia says.

Flora is impacted too. Plants exposed to artificial light can experience disrupted natural cycles, leading to delayed leaf fall in deciduous trees, early budburst in spring, and asynchronous flowering, interfering with pollination.

Taken as a whole, these effects highlight a systemic issue: artificial light at night can profoundly alter ecological dynamics for plants and animals alike.

Understanding these impacts, countries and organisations worldwide have taken proactive steps to reduce light pollution and protect wildlife. DarkSky International has been instrumental in promoting and certifying 'Dark Sky Places' around the globe. In our region, that goes as far back as 2012 with the designation of New Zealand's Aoraki Mackenzie International Dark Sky Reserve (see *Dark sky delight*, page 112), the first of its kind in the Southern Hemisphere.

France, for another example, has introduced a decree to protect wildlife by limiting artificial lighting in rural and conservation areas, ensuring migratory routes remain intact. These 'dark-sky corridors' – continuous stretches of naturally dark or low-light landscapes – align with existing green and blue infrastructure, providing safe passage for animals and reducing the disorientation caused by artificial light. They're essential for preserving biodiversity.

As a nation renowned for its extraordinary biodiversity and backed by world-class scientific expertise, Australia is uniquely positioned to lead in light-pollution management. But while the federal government's National Light Pollution Guidelines for Wildlife offer a strong foundation, Australia currently lacks a dedicated authority to regulate or enforce lighting ►

standards. Despite the common misconception, environmental protection authorities don't monitor these impacts.

Absent of a central body to implement and enforce them, even the most well-intentioned designs can fall short. For example, wildlife crossings intended to reconnect fragmented habitats may be rendered ineffective if illuminated by floodlights that disorient nocturnal species. Without coordinated monitoring and regulation, light pollution continues to erode ecological integrity, diminish the effectiveness of conservation infrastructure and undermine national efforts to protect native wildlife.

Australia has some of the darkest, clearest and most accessible night skies on the planet. Our open landscapes and low population density provide ideal conditions for stargazing and ecological preservation. But we're also one of the slowest nations to recognise the value of this asset. In the UK – where true darkness is scarce – people flock to designated dark-sky events in the thousands, sometimes for nothing more than a faint glimpse of the Milky Way. In contrast, many Australians live within reach of pristine starfields and rarely, if ever, look up. It begs the question: do we only value what we're about to lose?

FORTUNATELY, A QUIET revolution is underway. Australian communities, councils and conservationists are embracing dark-sky principles – installing shielded lighting, adopting curfews and seeking international recognition for their efforts.

Warrumbungle National Park in western New South Wales became Australia's first International Dark Sky Park in 2016, inspiring similar movements in urban and remote areas alike. Success stories include Palm Beach Headland – Australia's first designated Urban Night Sky Place – on Sydney's Northern Beaches; the community-driven initiative in Carrickalinga, South Australia; the expansive River Murray International Dark Sky Reserve in SA; and the remote sanctuaries of Arkaroola and Winton in SA and Queensland respectively. Together, they prove darkness can be reclaimed even in the modern world. These areas, officially recognised by DarkSky International, are results of collaboration between science, community and conservation groups.

However, Nalayini Brito-Davies, president of DarkSky's board of directors, says we're a long way from realising the full potential of Dark Sky Places. "They currently cover just 0.3 per cent of Australia's landmass, but [represent] a unique and vast opportunity," Nalayini says. "Dark Sky Places offer a rare intersection of benefits across tourism, health and environmental stewardship. They draw astrotourists in search of authentic night-time experiences, strengthening local economies sustainably."

Increasing tourist numbers reflect an emerging trend known as 'last-chance tourism' – a growing desire to see threatened

SAVE THE NIGHT

Marnie Ogg, Australasian Dark Sky Alliance's Director Outreach, explains what we can do to reduce light pollution.

Protecting the night touches every corner of society: climate policy, biodiversity conservation, tourism, public health, energy efficiency and cultural heritage. It requires a shift in thinking. Whether you're a policymaker, planner, homebuilder, teacher, or simply someone who loves the stars – this is your invitation to be part of a national movement.

The truth is, every one of us can make a difference. And unlike with other pollutants, the results are immediate.

Choose warm-coloured, downward-facing lighting for your home and garden. Install timers and motion sensors to ensure lights are only on when needed. Talk to your council about streetlight design. Support dark-sky tourism. Host a star party. Measure night-sky brightness with a smartphone app. Educate your neighbours. Even one bulb, one conversation, one evening of turning out the lights can make a difference.

The solutions exist. The urgency is real. And the night is waiting.

Warrumbungle NP – officially designated a Dark Sky Park – offers some of the clearest and most breathtaking night skies in Australia.
Photo credit: Ola Garfendal

natural wonders before they disappear. From glaciers to coral reefs, travellers are drawn to experiences that feel fleeting. Pristine night skies are joining this list. As light pollution spreads globally, truly dark places are becoming rare, even in rural areas. For many travellers, seeing the Milky Way for the first time – or perhaps the last – is now a bucket-list moment. Australia is uniquely positioned to offer these experiences, with breathtaking dark skies that still outshine much of the world. But the clock is ticking. Without protection, these skies too may fade.

As such, Dark Sky Places aren't just tourism drawcards but also powerful educational and cultural platforms. They demonstrate good lighting practices and invite people to engage in a truly dark night – something nearly two-thirds of the global population can no longer experience.

CHILDREN ARE KNOWN to be afraid of the dark, but in today's world, most of us – children and adults alike – have never truly been in it. Streetlights glow through bedroom curtains. Nightlights hum in hallways. Cities never really sleep. For many people, darkness feels frightening simply because it's unfamiliar. We grow up surrounded by the idea that light equals safety, and anything beyond its glow must be dangerous.

But for First Nations Australians, darkness has long held a different meaning. It's far more than the absence of light; it's a living archive of knowledge, memory and law. For generations, cultural stories helped children respect the night. Tales of creatures such as the bunyip, said to lurk in waterways, weren't just ►

7 AUSTRALIAN DARK SKY PLACES

From national parks to local communities and remote huts, these seven locations are leading the way in embracing the darkness.

Warrumbungle National Park (NSW)
Certified in 2016, Australia's first Dark Sky Park restricts artificial light in nearby areas, supporting astronomy at adjacent Siding Spring Observatory and preserving pristine skies for visitors and researchers.

River Murray Dark Sky Reserve (SA)
This 3200sq.km reserve in the Murraylands enforces strict lighting limits. It protects some of the darkest skies in the Southern Hemisphere, supporting eco-tourism and light-sensitive wildlife.

Palm Beach Headland (NSW)
Australia's first Urban Night Sky Place reduced light pollution by shielding lights, using warm tones and engaging locals. Stargazing now thrives here, proving dark skies are possible in urban settings like Sydney.

Carrickalinga (SA)
The first Dark Sky Community in Australia replaced streetlights and adopted lighting policies. The naturally dark town now supports nocturnal wildlife and offers residents brilliant night skies year-round.

Winton (QLD)
Winton promotes stargazing through festivals and lighting ordinances. Its clear, dry skies and community efforts to reduce glare have made it a hub for astrotourism and outback astronomy.

Arkaroola Wilderness Sanctuary (SA)
A remote sanctuary that enforces strict lighting controls. Arkaroola offers near-pristine night skies for astronomy and ecotourism while protecting native species that are reliant on natural light cycles.

Kestrel Nest EcoHut (NSW)
This off-grid private stay 26km south-west of Gundagai recently became Australia's first Dark Sky Lodging. It comes with stargazing hammocks and an outdoor bath from which to soak up the starry night sky.

Preserving dark skies is no longer a fringe concern but rather a national opportunity.

Light pollution can confuse and disorient diurnal animals, including this pied oystercatcher (*Haematopus longirostris*) in Perth that's active and foraging at night.
Photo credit: Jason Moore

spooky legends but gentle warnings to keep kids close and encourage caution. The stars and lunar cycles are inseparable from land and sea, guiding everything from ceremony to daily life. The night sky holds creation stories, seasonal cues, navigational tools and ceremonial meaning passed down for tens of thousands of years. The Emu in the Sky – a constellation shaped not by the stars themselves but by the dark spaces of the Milky Way – is just one example of this deep cultural connection.

"Sky stories have long guided how we live on and care for Country," says Peter Swanton, a Gamilaraay/Yuwaalaraay man, astrophysics graduate and PhD candidate at the Australian National University. "Songlines, for example, are celestial navigation systems that mirror the landscape, enabling journeys across vast distances by mapping the land onto the stars. Other stories reflect the behaviours of animals, signalling the availability of food, water and seasonal resources. Most importantly, sky stories are vital repositories of knowledge – oral archives that preserve and transmit information across generations.

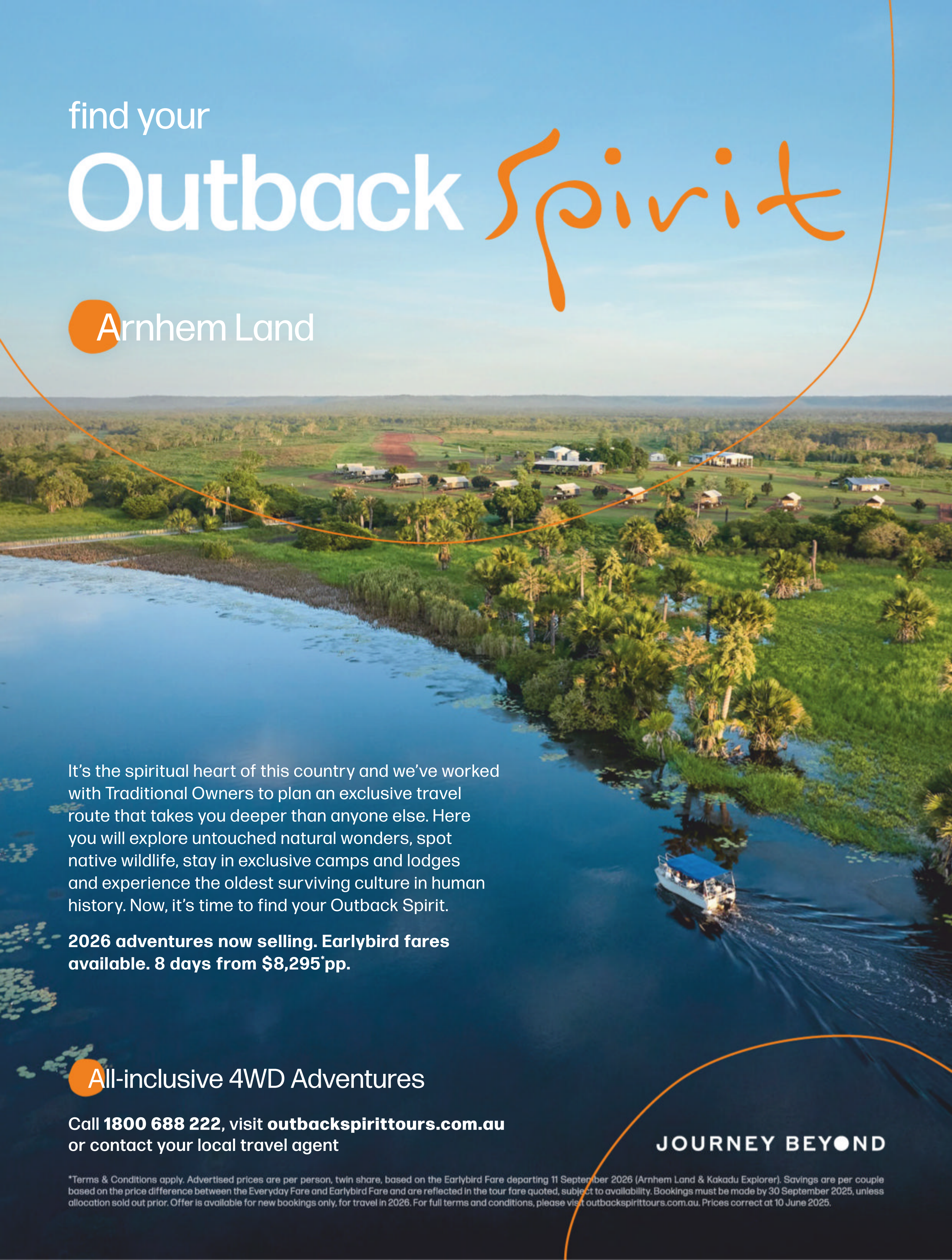
"Light pollution increasingly obscures the night sky, access to these stories and the cultural knowledge embedded within them. Losing sight of the stars means potentially severing a connection to thousands of years of ancestral wisdom."

MUCH OF THE progress in raising awareness in Australia about light pollution has been driven by the Australasian Dark Sky Alliance (ADSA), a non-profit organisation dedicated to preserving night skies across Australia and New Zealand. According to ADSA, light pollution is "one of the fastest-growing environmental threats on the planet". The University of Exeter backs up this statement, reporting global light pollution has increased by at least 49 per cent over 25 years, but adds that the true increase may be up to 270 per cent globally.

In March 2025, ADSA held the Valuing Darkness Symposium in partnership with the federal Department of Climate Change, Energy, the Environment and Water. The event brought together experts from lighting, ecology, Indigenous knowledge systems, planning and astronomy, leading to the establishment of the Dark Sky Roundtable, an ongoing collaboration pushing for reforms in policy and infrastructure. Industry is following suit. Architects, urban designers and lighting suppliers are now uniting around environmentally responsible design.

It's a sign that preserving dark skies is no longer a fringe concern but rather a national opportunity. It intersects with climate policy, biodiversity conservation, tourism, public health, energy efficiency and cultural heritage. Recognising darkness as an environmental asset requires a shift in thinking: to view light as a pollutant when overused, and darkness as a natural part of our environment.

In a world increasingly illuminated, the quiet depths of night provide a vital space where nature's rhythms can continue undisturbed. Preserving these moments of true night isn't about rejecting progress; it's about finding balance, respecting the natural cycles that sustain life, and ensuring future generations can still experience the stars above – and the calm that only darkness can bring. ■



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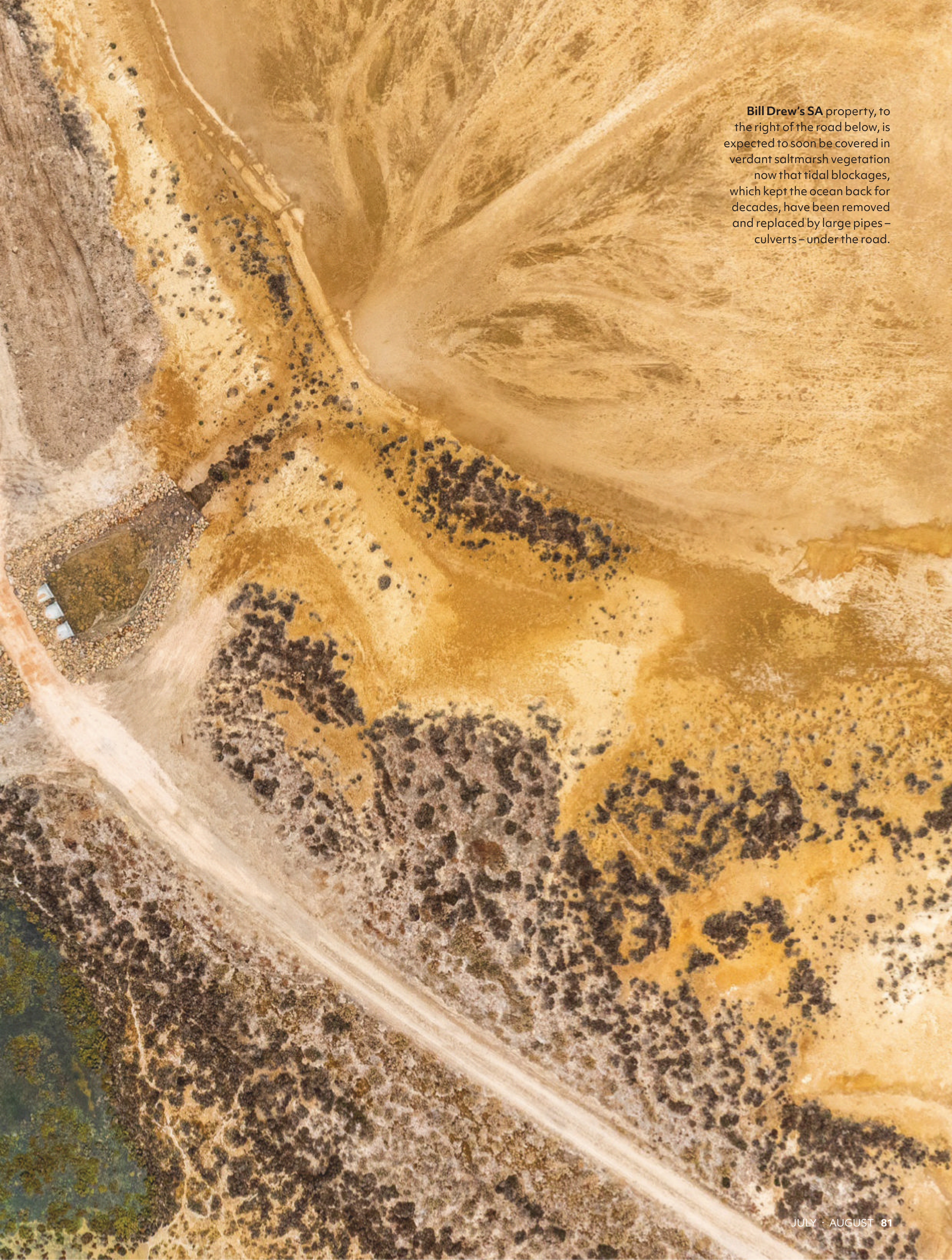
BRINGING IN THE SEA

STORY BY **KAREN MCGHEE**
PHOTOGRAPHY BY **ALEX PIKE**

Could so-called blue carbon be key to resolving some of Australia's biggest environmental and cultural challenges?



Bill Drew's SA property, to the right of the road below, is expected to soon be covered in verdant saltmarsh vegetation now that tidal blockages, which kept the ocean back for decades, have been removed and replaced by large pipes – culverts – under the road.

Uncle Jeffrey Newchurch and Flinders University marine biologist Professor Sabine Dittmann have spent many hours walking and talking on Winaityinaityi Pangkara, exchanging knowledge about the wetlands here.

THE OCEAN HAS begun spilling across Bill Drew's farmland north-west of Adelaide, and he's ecstatic. The seawater inundation of his 255ha property is an early success story within a larger project restoring saltmarsh and mangrove habitats near Webb Beach, on the eastern side of South Australia's Gulf St Vincent.

Bill is a big, burly country bloke of few words, but he's clearly revelling in the fish and shorebirds that have begun to appear on his newly saturated property. And he's buoyed by how his four children, aged from 2–8 years, have been responding to the transformation of land beneath their feet since decades-old blockages were recently removed, bringing the sea back in.

"I've been telling everybody about it," Bill says, conceding the land – which his father, also Bill, bought with his parents more than 40 years ago for grazing livestock – had never been particularly productive as farmland. "But now the water is back in – wow! I've never seen it like this before. This is about making a better future for the kids. It's all for the kids." One day, this newly flooding environment might also bring in money for the family.

The larger undertaking seeing Bill's land slowly return to its former natural glory involves 156ha of wetland habitat in SA's first registered Blue Carbon Ecosystem Restoration project. 'Blue carbon' is the carbon contained in vegetated coastal habitats, and it could be significant to Australia achieving its net-zero emissions target. The project near Webb Beach has been headed by not-for-profit conservation organisation The Nature Conservancy (TNC) Australia but has involved almost a dozen other key participants – a multi-organisational approach that has been integral to the success of this restoration. As the saying goes, 'it takes a village'.

Other partners include Flinders and Adelaide university research teams, Kaurna Traditional Owners, Adelaide Plains Council, BirdLife Australia, Birds SA, local natural resources management groups, and National Parks and Wildlife Service South Australia. The latter jointly manages, with Kaurna rangers, the neighbouring Adelaide International Bird Sanctuary National Park – also known as Winaityinaityi Pangkara, a Kaurna term recognising it as 'bird country'. The sanctuary is home to about 27,000 birds. Being at the southern end of the famed East Asian–Australasian Flyway migratory route – which links Northern Hemisphere breeding grounds with feeding grounds at the other end of the world – it's also globally important for dozens of migratory species.

Kaurna Elder Uncle Jeffrey Newchurch, now in his 60s, grew up near this place. He moved away for a while but returned, mindful he holds much cultural knowledge that he has a responsibility to pass on. He recalls shadowing his dad and aunties here as a child, learning about the local animal and plant life and the ways of Country.

Tread the saltmarshes, mudflats and mangroves of Winaityinaityi Pangkara with Uncle Jeffrey and his deep connection to this area is palpable. "When you walk Country in silence, Country opens up to you. Country lets you know," he says as he strides quietly over the damp ground, his long, grey beard fluttering in a strong onshore breeze as the calls of seabirds fill the air. "This place has always been significant. My father and the old people taught me about the birds. They're a calendar to us; [they tell us] the seasons. You get to know them and their habits and, hopefully, learn some of their ways."

As this land continues to heal after the removal of tidal blockages that interfered with its natural rhythms for decades, it's hoped it will bring huge cultural benefits for new generations of Kaurna.

BILL'S DAD, WHO has passed away, began working with TNC back in 2019 when they first started coastal restoration around Webb Beach. But in 2022, the work got a massive nudge forward thanks to $2.9 million in federal funding under the Blue Carbon Ecosystem Restoration Grants. "The intention was to pilot 'the blue carbon method'

It's regular immersion like this in saltwater that makes vegetation in coastal wetlands so good at sequestering and locking away carbon.

[of capturing and locking away carbon] here and see how we could run through every step, right from the feasibility stage to implementing a permanent reconnection to the sea," explains Kylie Moritz, conservation coordinator at TNC. "Because these projects don't work in isolation, it was a whole-of-landscape approach that we needed to take."

The true potential of the site to store huge amounts of blue carbon won't be fully realised for decades. But it's the multiple co-benefits created by this restoration project that make it more immediately valuable. Those, of course, include the already-evident cultural benefits. But sampling and monitoring are showing that restoring the saltmarshes, by bringing them back under tidal influence, has also begun to reap many biodiversity rewards. "Much of this wetland site hadn't had seawater-flushing events for 50 years. So as freshwater from rainfall settled on it and evaporated, it drew salt up into the top layer [of sediment] so plants couldn't grow," Kylie says, adding that this meant the saltmarshes became lifeless salt pans. "But we can already see that salt is being flushed out, which means we might get plants becoming established by this spring…much quicker than what we expected."

Sampling has also shown that, in nearby tidal creeks, diverse fish and crustaceans – including commercially important species such as whiting, mullet, garfish, black bream, flounder, congolli, western king prawn and blue crab – were present. Analyses undertaken in partnership with SA Research and Development Institute, Flinders University and the University of Newcastle indicate that saltmarsh vegetation provided important nutrition and a food source for some of these species. "This indicates the flow-on impacts on local animal species of regenerating saltmarsh vegetation are likely to be huge, passing right along not only local food chains but way beyond," says Flinders University marine biologist Professor Sabine Dittmann.

What's more, there's strong evidence the restoration here will help futureproof this coastline against predicted sea-level rising. Ecological modelling shows that as the sea level rises, the saltmarsh here will transition into mangrove forest, and that will help secure the shore.

WHAT SETS BLUE carbon apart from any other carbon? Chemically speaking, not a lot. The term appeared in scientific literature from about 2009 as part of the ever-expanding lexicon around climate change. It specifically relates to carbon contained in marine ecosystems – notably mangrove forests, seagrass beds and saltmarshes.

To appreciate why that might be significant, it's useful to revisit the basic biological principle that all green plants absorb carbon dioxide from the atmosphere during the process of photosynthesis and use the carbon component to build their roots, stems and trunks. It's this that makes living green vegetation – in either terrestrial or aquatic habitats – a natural storehouse for carbon.

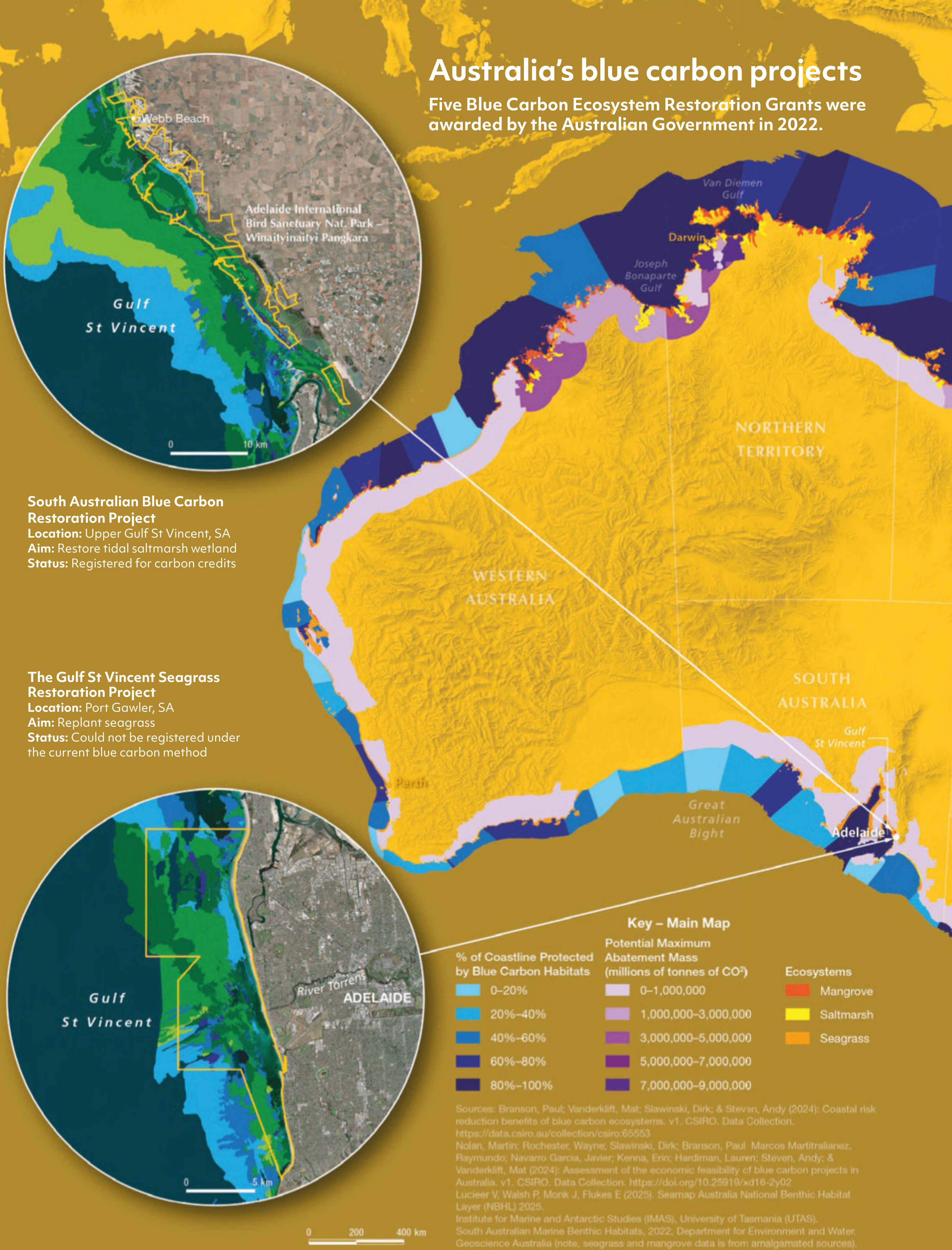
"Photosynthesis is still the best carbon capture mechanism we know of," says marine ecologist Dr Mat Vanderklift, a leading blue carbon researcher with CSIRO. "And so far, humans haven't invented anything better than what nature already does well."

It's what makes the massive cool temperate forests of the Northern Hemisphere and the tropical rainforest of the Amazon so critical to the health of the planet. These

Continued page 86 ▶

Australia's blue carbon projects

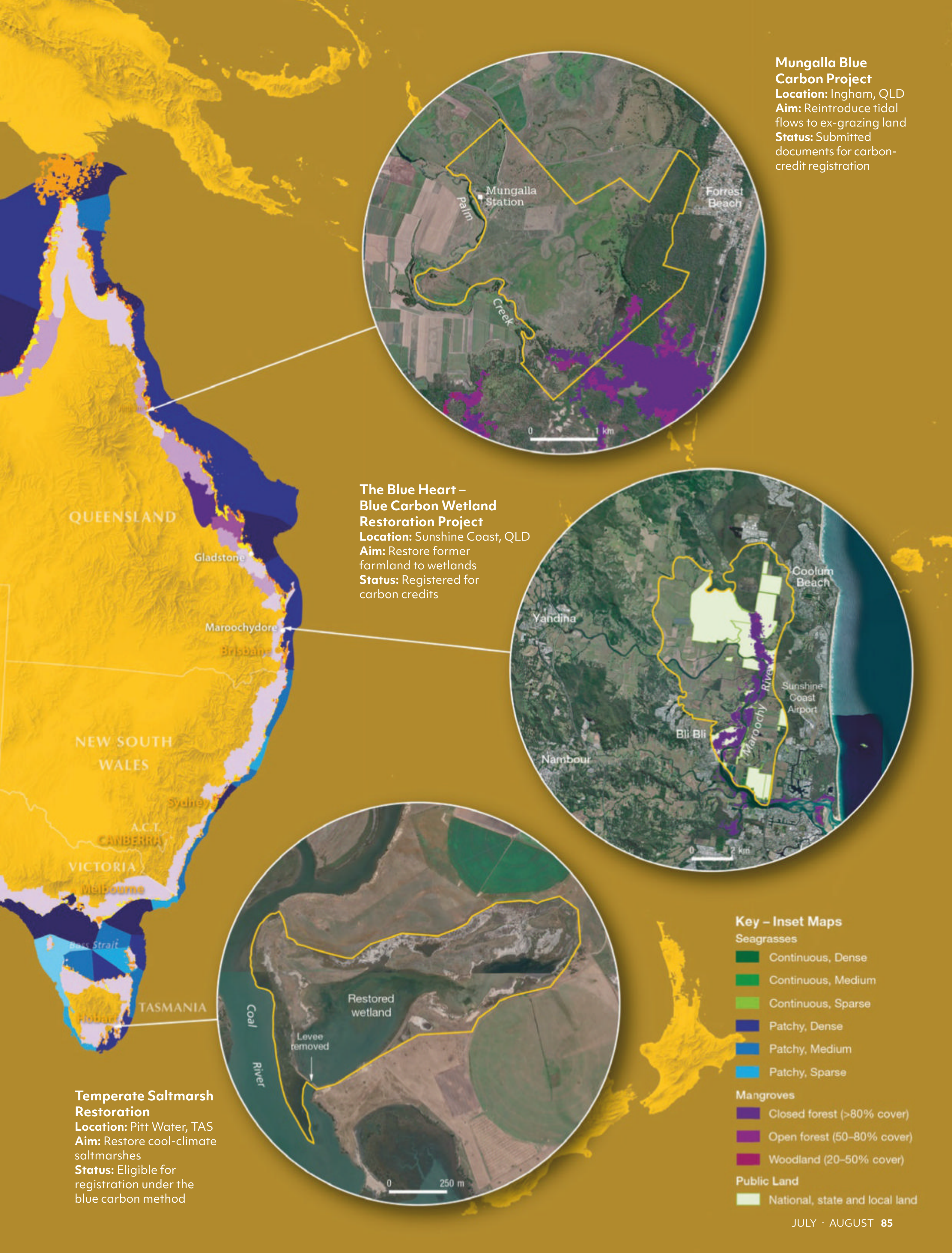
Five Blue Carbon Ecosystem Restoration Grants were awarded by the Australian Government in 2022.


Webb Beach
Adelaide International Bird Sanctuary Nat. Park – Winaityinaityi Pangkara
Gulf St Vincent
0
10 km
Gulf St Vincent
River Torrens
ADELAIDE
0
5 km
Van Diemen Gulf
Darwin
Joseph Bonaparte Gulf
NORTHERN TERRITORY
WESTERN AUSTRALIA
SOUTH AUSTRALIA
Gulf St Vincent
Perth
Great Australian Bight
Adelaide
0
200
400 km
Key – Main Map
% of Coastline Protected by Blue Carbon Habitats
0–20%
20%–40%
40%–60%
60%–80%
80%–100%
Potential Maximum Abatement Mass (millions of tonnes of CO²)
0–1,000,000
1,000,000–3,000,000
3,000,000–5,000,000
5,000,000–7,000,000
7,000,000–9,000,000
Ecosystems
Mangrove
Saltmarsh
Seagrass

South Australian Blue Carbon Restoration Project
Location: Upper Gulf St Vincent, SA
Aim: Restore tidal saltmarsh wetland
Status: Registered for carbon credits

The Gulf St Vincent Seagrass Restoration Project
Location: Port Gawler, SA
Aim: Replant seagrass
Status: Could not be registered under the current blue carbon method

Sources: Branson, Paul; Vanderklift, Mat; Slawinski, Dirk; & Stevan, Andy (2024): Coastal risk reduction benefits of blue carbon ecosystems. v1. CSIRO. Data Collection. https://data.csiro.au/collection/csiro:65553
Nolan, Martin; Rochester, Wayne; Slawinski, Dirk; Branson, Paul. Marcos Martitralianez, Raymundo; Navarro Garcia, Javier; Kenna, Erin; Hardiman, Lauren; Steven, Andy; & Vanderklift, Mat (2024): Assessment of the economic feasibility of blue carbon projects in Australia. v1. CSIRO. Data Collection. https://doi.org/10.25919/xd16-2y02
Lucieer V, Walsh P, Monk J, Flukes E (2025). Seamap Australia National Benthic Habitat Layer (NBHL) 2025.
Institute for Marine and Antarctic Studies (IMAS), University of Tasmania (UTAS).
South Australian Marine Benthic Habitats, 2022, Department for Environment and Water.
Geoscience Australia (note, seagrass and mangrove data is from amalgamated sources).


QUEENSLAND
Ingham
Gladstone
Maroochydore
Brisbane
NEW SOUTH WALES
Sydney
A.C.T.
CANBERRA
VICTORIA
Melbourne
Bass Strait
TASMANIA
Hobart
Mungalla Station
Palm
Creek
Forrest Beach
0
1 km
Coolum Beach
Yandina
Sunshine Coast Airport
Maroochy
River
Bli Bli
Nambour
0
2 km
Restored wetland
Coal
River
Levee removed
0
250 m

Mungalla Blue Carbon Project
Location: Ingham, QLD
Aim: Reintroduce tidal flows to ex-grazing land
Status: Submitted documents for carbon-credit registration

The Blue Heart – Blue Carbon Wetland Restoration Project
Location: Sunshine Coast, QLD
Aim: Restore former farmland to wetlands
Status: Registered for carbon credits

Temperate Saltmarsh Restoration
Location: Pitt Water, TAS
Aim: Restore cool-climate saltmarshes
Status: Eligible for registration under the blue carbon method

Key – Inset Maps

Seagrasses
- 🟩 Continuous, Dense
- 🟩 Continuous, Medium
- 🟩 Continuous, Sparse
- 🟦 Patchy, Dense
- 🟦 Patchy, Medium
- 🟦 Patchy, Sparse

Mangroves
- 🟪 Closed forest (>80% cover)
- 🟪 Open forest (50–80% cover)
- 🟥 Woodland (20–50% cover)

Public Land
- ⬜ National, state and local land

huge terrestrial forested places are literally massive life-support systems for the planet because they release oxygen while sucking in carbon dioxide. But, very importantly, they also sequester massive amounts of that carbon, keeping it out of the atmosphere where it drives climate change. The kicker, of course, is that when this vegetation dies, it releases all the carbon it contains back into the atmosphere.

"So, plants take carbon out of the atmosphere and put it in wood. And if it's in wood, it's not in the atmosphere. That's good for climate change," Mat says. "But collectively, as scientists, once we began looking closer, it was clear that a lot of carbon also goes into the soil." In terrestrial systems – such as forests and woodlands – it doesn't stay in the soil for long because it's usually broken down quickly by organisms such as bacteria, fungi and earthworms. "On land, there are all these decomposers in the soil, and you give them a bit of carbon and that's like food, and they'll munch through it," Mat says. "But these coastal wetlands systems have conditions that are conducive to carbon *staying* in the soil."

And the regular bathing of these places by saltwater delivered by tides is the reason why. "These [decomposer] organisms respire like we do, taking in oxygen and breathing out carbon dioxide," Mat continues. "But in salty coastal ecosystems, the decomposers tend not to get the oxygen they need, so they can't decompose as fast." The result is that carbon tends to remain locked away in the soils of these systems for considerably longer. And the reason that has had climate scientists so interested is because it turns out that healthy coastal wetlands – blue carbon systems – have the capacity to store more carbon per unit area than land-based forests.

Coastal wetlands... have the capacity to store more carbon per unit area than land-based forests.

Australia, of course, has large tracts of important woodlands and forests, many of which are significant on a global stage for various reasons. As carbon stores, however, these places can't match what's available in other countries in terms of total area.

But blue carbon is a different story.

FEW OTHER COUNTRIES have Australia's blue carbon stores. Firstly, we have a lot of blue carbon habitat (see map on previous page). With 59,681km of coastline (including Tasmania and offshore island territories) according to Geoscience Australia – the sixth longest in the world – Australia has more mangrove, seagrass and saltmarsh habitat than most nations. Secondly, Australia's collective scientific knowledge in this space is huge. In fact, when it comes to scientists with blue carbon and coastal ecosystem expertise, we punch considerably above our weight internationally.

That's probably not surprising when you consider the strong connection to the coast that so many Australians have. According to the Australian Bureau of Statistics, 85 per cent of our population lives within 50km of the coastline, suggesting that – culturally, at least – there's a lot of vested interest in maintaining and resurrecting the health of coastal habitats. These vegetated tidal places have had, and still have, a massive cultural connection to First Nations people across multiple millennia, particularly because of the high biodiversity and food resources they contain. And today these places are also prized for their recreational and lifestyle roles, and as natural systems of great scenic beauty.

But, perhaps even more importantly, a healthy fringe of coastal wetland habitat is fundamental to the way this country functions. For example, these places act like kidneys, filtering out impurities from coastal environments. They also hold together and stabilise the coast against sea surges and storms, provide habitat and food for coastal animals – from fish to birds – and act as protected nursery sites for the young of marine creatures that often grow to adulthood in waters way beyond our shores.

Being Australia's largest national research organisation tasked with finding answers to some of the country's most pressing environmental problems, CSIRO began seriously looking into blue carbon and its potential just over a decade ago. "At the time, all the data was coming out of the Northern Hemisphere, and we really didn't know what the potential was in Australia," says blue carbon expert Dr Andy Steven, who was then tasked by CSIRO with leading a national consortium of relevant researchers to collate all available blue carbon information. It led to a landmark scientific paper, *Australian vegetated coastal ecosystems as global hotspots for climate change mitigation*, published in *Nature Communications* and written by dozens of Aussie experts spearheaded by lead author Dr Oscar Serrano from Edith Cowan University's Centre for Marine Ecosystems Research.

Ever since, Mat and Andy have been leading CSIRO's rising exploration of the potential of blue carbon, not only in Australia but with many nations across the Indo–Pacific. The work there is providing the science underpinning how blue carbon can contribute to climate change mitigation, while also improving livelihood opportunities for communities with a dependence on, and custodial responsibility for, ensuring the health of coastal ecosystems.

The CSIRO team laid the foundation for the development of the 'tidal restoration of blue carbon ecosystems method' for Australia's Clean Energy Regulator – a way to measure, and potentially monetise, how much carbon is captured in wetland systems. It's the latest 'method' to be approved in Australia as a way of 'farming carbon' to incentivise landholders to protect and resurrect natural ecosystems.

The opportunity to farm carbon for financial return was first made available to landholders in Australia in 2011 through the federal Carbon Farming Initiative, now the Australian Carbon Credit Unit (ACCU) scheme. Landholders can register approved land-use activities with the Clean Energy Regulator and earn ACCUs – tradeable carbon credits – by either preventing the production of atmospheric carbon or by drawing it down from the atmosphere and locking it away. One ACCU represents one tonne of carbon and is presently worth about $35.

Believing blue carbon ecosystems might help to offset global carbon dioxide emissions, the CSIRO team set out in 2022, with funding from industrial giant BHP, to map the blue carbon restoration potential around Australia – "to measure and quantify the net emissions reduction potential of Australia's mangroves, seagrasses and saltmarshes". What particularly interests organisations such as BHP in these sorts of projects is the potential they offer as carbon-offset opportunities.

Residents around the Blue Heart project, which is helping recover wetland habitat on the lower floodplain of the Maroochy River in Southeast Queensland, have reported seeing more birdlife than usual, notably black swans.

For CSIRO, Mat says, there were two major motivations for the project. "One was [to identify] how much carbon abatement we could get if you applied [the method] everywhere in Australia that you could do it," he says. "And then [to identify] whether the kind of cost benefit was worthwhile." In that way it could let landholders know, for example, whether the long-term expense of removing floodgates and resurrecting original wetland habitat would be financially worth it.

It turns out most potential lies in northern Australia, notably parts of Queensland, the Northern Territory and Western Australia. "For example, there's this 'ponded pasture' system in a lot of north-eastern Australia, where essentially the tides are kept out with a kind of wall or barrier," Mat says. "But when it rains, it turns into a mostly freshwater area that tends to generate a lot of methane and other greenhouse gases. So, if you let the tide back in, you stop producing those other greenhouse gases, as well as getting the carbon back."

The downside is that ponded pastures tend to be highly productive and protect beef producers against drought. And those farmers aren't interested, anyway, in carbon when they can grow cattle.

Andy points out that traditional approaches of measuring blue carbon potential were limited – including the widely used 'bathtub' approach, which simply assesses where water goes if you fill a landscape with it. "[That is] not particularly accurate," Andy says. "So, we came up with a much more resolved and reliable method of looking at how far the inundation is likely to go across land." This improved inundation mapping method has been one of the most groundbreaking outcomes of the work.

"The other innovative aspect," Andy continues, "was combining that with economic modelling to be able to say across different land uses that, if a certain area was inundated, how it would stack up when you consider other factors like the value of the land, the price of carbon, and the establishment costs [of a rehabilitation program]." This recently completed mapping project is valuable not only for policymakers but also landholders, developers and anyone else looking to make decisions about coastal land-use.

"No one is pretending blue carbon is a silver bullet that'll solve climate change, because you can't do that without dealing with the fossil fuel issue," Mat says. In fact, he adds that if all blue carbon sites worldwide were recovered and maintained, the carbon they'd lock away would represent only about 3 per cent of global emissions. That's equivalent to the emissions of the global airline industry.

"We haven't yet got a sustainable aviation fuel, so we're going to be using jet fuel for some time yet," Mat says. "So, while we're still trying to solve those sorts of things, [blue carbon] is a contribution."

WHILE MAT AND Andy grapple with the practical challenges of mapping, modelling and quantifying Australia's blue carbon potential, the Great Barrier Reef Foundation (GBRF) has been exploring how the nascent blue carbon marketplace could help safeguard the troubled ►

Plants such as this cottonwood – a native Australian hibiscus – live along the Maroochy River wetlands and were once used here extensively by the Kabi Kabi people.

CSIRO's Lauren Hardiman and Dr Ana Bugnot brave swarms of mosquitoes as they collect samples in the recovering wetland habitat supported by the Blue Heart project.

reef. It sees blue carbon as part of the ultimate solution to climate change-driven mass coral bleaching. Restoring blue carbon ecosystems would also contribute to improving water quality because they trap sediments and nutrients that can run off from agricultural land.

For now, however, it's the co-benefits of blue carbon-based habitat restoration – like healthier coastal ecosystems – that are of most interest. When all things are considered – for example, the cost of removing tidal barriers to encourage mangroves back onto floodplains versus the value of farming cattle and sugarcane on the same floodplains – the economics for blue carbon over much of Queensland just don't yet stack up. But the foundation believes there's significant potential in restoring lost or damaged seagrass meadows along the reef – habitats known to lock away large amounts of carbon in sediments – though no carbon-credit method exists yet for seagrass restoration.

Seagrass restoration can be laborious, time-consuming and extremely expensive, requiring the transplant of individual plants. But, says Will Hamill, the GBRF's director of coastal habitat restoration, a world-first seagrass planting project by Central Queensland University's Coastal Marine Ecosystems Research Centre is showing enormous potential trialling a new scalable way of sowing seagrass. "At the port of Gladstone, we've invested in a large seagrass nursery – the biggest in the world – as a demonstration for seed-based seagrass restoration," Will says. "It's like a knowledge hub to share how this technique works, and it's supporting a number of seagrass restoration sites in that region."

MEANWHILE, NOT FAR from one of Australia's fastest-growing urban areas in Southeast Queensland, another significant blue carbon project has been attracting a lot of attention. Appropriately named Blue Heart, it encompasses about 5000ha on the lower floodplain of the Maroochy River. It too was a recipient of one of the federal government's five Blue Carbon Ecosystem Restoration Grants – in this case, $2,036,000.

The Blue Heart area was, for much of last century, dominated by agricultural activities – notably sugarcane farming, which began declining as profit margins tightened after the nearby Moreton Central Sugar Mill, in the town of Nambour, closed in 2003. Being in the subtropics, the verdant vegetation of Blue Heart looks vastly different to what grows at the Gulf St Vincent blue carbon site in SA. But the blue carbon approach here shares many similarities with that site, especially in terms of its complex logistics and multi-partnered approach.

The Blue Heart blue carbon project is spearheaded by the local Sunshine Coast Council, but other active partners include the area's Kabi Kabi Traditional Owners, local utility Unitywater, the Queensland Government, TNC, and researchers from the University of the Sunshine Coast, The University of Queensland, Griffith University and the University of New South Wales. As is the case at the SA site, tidal flows in the low-lying Blue Heart precinct have been altered for decades by floodgates, some of which are now being removed. Even with floodgates in place, flooding has long been a problem for the area and has become worse this century with shifting rainfall patterns linked to climate change. It's predicted the area will be completely inundated due to sea-level rise by 2100.

"We've already seen a lot of tidal inundation out there," says senior environment project officer with the Sunshine Coast Council, Dr Sonia Marshall, who's managing the project. "About one-third of the Blue Heart area is publicly owned land – so it's owned by a government entity – and the rest is privately owned land. There are a number of projects happening in the Blue Heart to try to support the landholders who live there and [to encourage continued] recreational opportunities.

"But for now, the blue carbon project is only happening on council-owned land. It's a trial to test the feasibility of the blue carbon farming method, to see if it's something that landholders here might be able to use in the future when tidal inundation becomes even more prominent."

For Sonia, however, the real value of the Blue Heart project has been the extraordinary cooperation it has ignited across

> **[Kerry is] optimistic the Blue Heart project will release the pressure that has been facing this habitat for many years.**

the carbon industry – including not-for-profits, academic institutions, government, and carbon-related businesses – and the co-benefits that are already starting to be seen. These include the return of mullet and other fish to the tidal creeks and rivers in the area. Anecdotally, water birds are also increasing, with recent reports of brolgas and jabiru storks that haven't been seen here in years. Black swans, which First Nations stories suggest used to be plentiful in the area but have rarely been seen in recent years, are returning in larger numbers.

"Most people have known about the benefits of coastal wetlands for decades, but putting carbon [into the equation] alerts governments to their importance," says The University of Queensland marine ecologist Professor Catherine Lovelock, one of Australia's leading blue carbon experts and someone who knows the Maroochy River site well. "The Blue Heart is a great collaboration because the Queensland Government, federal government and local governments all got involved. And it has a consortium of researchers all with the same sort of interest, and it stimulated more involvement with the Kabi Kabi. The tangible benefits here, like fishing and recreation, shouldn't be undersold. All of that collaborative kind of action is really worth a lot. So, relationships have started that will help them solve other problems."

Adaptation to sea-level rise is already a big issue for coastal Australia, Catherine adds, and is only going to get bigger and more expensive. That means restoration of these ecosystems is hugely important to how that problem is dealt with. "Increasing the flood volume on the landscape to slow things down to soak up that water – wetlands are good at that," she says. "Since colonisation, [we have] removed a lot of that capacity."

Kerry Jones, a Kabi Kabi Elder closely involved with the Blue Heart project, was born and raised on the Maroochy River. "My great-grandmother was probably one of the last full-blood ladies to live on this river [in 1917], and she played a major role here," Kerry recalls. "Some of the old cane farmers down near the river mouth said she used to sell fish, and mud crab, and native bush flowers in exchange for tobacco and flour."

The Maroochy River, he says, was his backyard. "I was always with my father, learning how to fish, hunt crab – and when he wasn't teaching me, I was following him, watching and observing," Kerry says. "We knew certain trees that were indicators for fish, crustaceans and molluscs. When these flowered, we knew these resources were coming in to season; this fish will be here in abundance when this one comes into flower. Our people moved around, followed them seasonal indicators and knew not to flog it – exhausting all them resources in one area all the time."

He's optimistic the Blue Heart project will release the pressure that has been facing this habitat for many years. "Our children need to reconnect with that, and I'd love it if we could have more Kabi people on Country to have that connectivity," Kerry says.

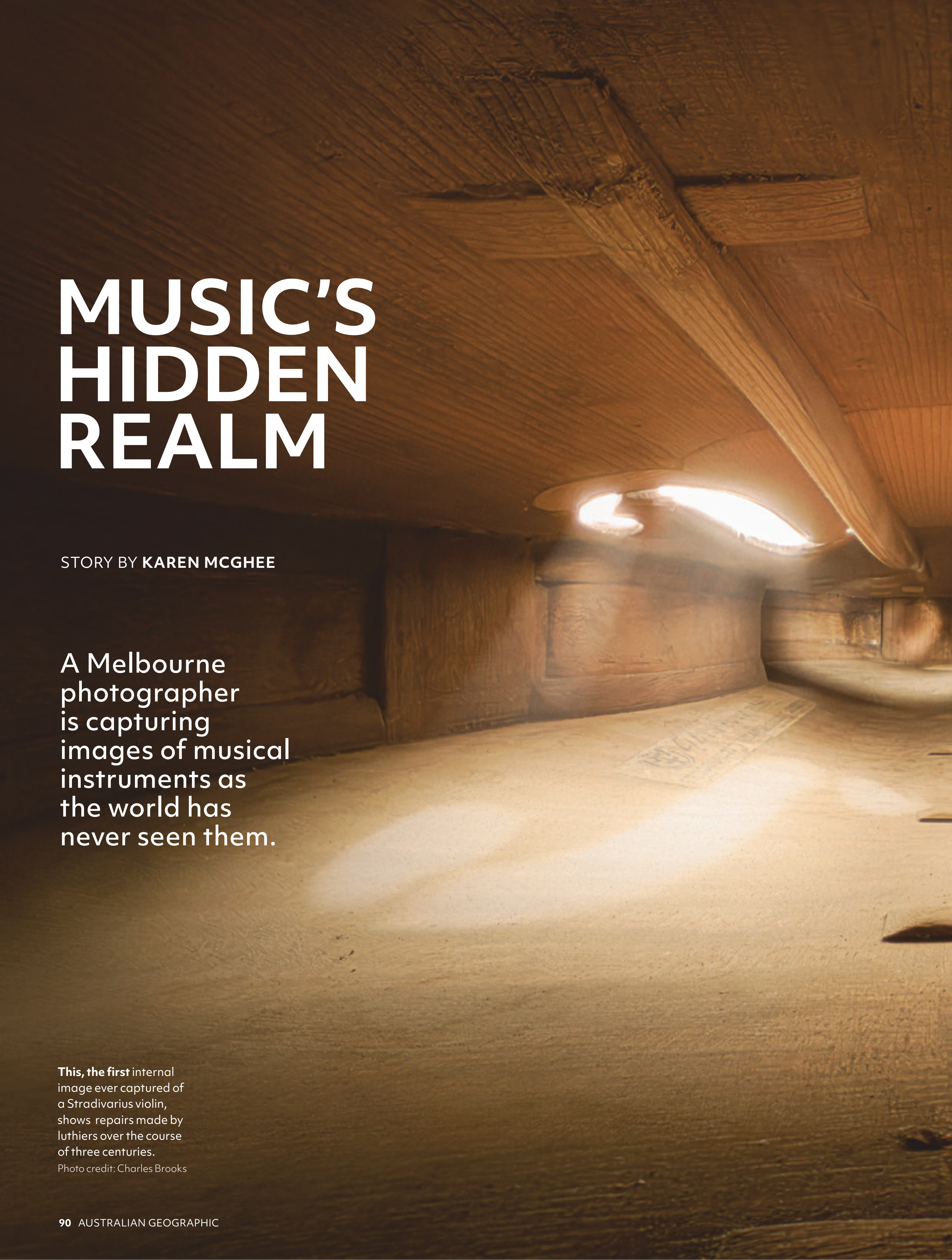
"I think that, as a human race, we've got to be in touch with Mother Nature more instead of destroying [her] – because once it's gone past a certain level, it's very hard to bring something back." ■

Dr Sonia Marshall and Kabi Kabi Traditional Owner Kerry Jones survey the recovery of habitat by Blue Heart's tidal restoration work.

MUSIC'S HIDDEN REALM

STORY BY **KAREN MCGHEE**

A Melbourne photographer is capturing images of musical instruments as the world has never seen them.



This, the first internal image ever captured of a Stradivarius violin, shows repairs made by luthiers over the course of three centuries.
Photo credit: Charles Brooks

THERE'S A DEFERENTIAL hush surrounding Melbourne-based master violin-maker Rainer Beilharz as he carefully removes the bottom end block, bridge, strings and tailpiece of a 1717 Stradivarius violin. He then fills the still-sealed body of the instrument with rice, gently swirls it around and tips it out, along with any 300-year-old specks of dust. Insured for $12 million – but in reality, priceless – this is one of only about 600 stringed instruments surviving today that bears the famed Stradivarius name.

In what will be a world-first, it's here today to be photographed – from inside – by Charles Brooks, a Melbourne-based photographer who specialises in capturing images of the interiors of musical instruments. Charles is the only person in the world who does this sort of highly technical specialist photography, which uses medical lenses. His images have been reproduced millions of times, and a Strad has been on his wish list for a while.

New Zealand-born Charles was himself an elite musician, having played during a 15-year career as the principal cellist with orchestras in China, Taiwan, Chile and Brazil. But he began to develop his unique style of photography when live music shut down worldwide during COVID. He recalled a famous series of photographs, from 20 years earlier, of the interiors of instruments from the Berlin Philharmonic, taken while they were being repaired. "It was a beautiful and famous series, but you could tell these were instruments in the process of being heavily repaired, and certain parts were missing," Charles says, explaining that he wondered what the view might look like taken from inside intact instruments. "And I thought, I'd love to do this with a Stradivarius, with a fine instrument. But you don't want to take the top off a Strad unless it's absolutely necessary. I mean, that might happen a couple of times in a century at most."

Charles had been a keen photographer since his high-school days and had continued to dabble with that passion during his years travelling the world as a performer. Initially his subjects were landscapes and night skies, then portraits of people. But after one protracted pandemic lockdown, he began exploring ways of photographing inside musical instruments. "I went down this rabbit hole at first, looking at commercially available probe lenses for photographers," Charles says. "They were too big, so I got a heat gun and melted off the casing of one, and that got me inside cellos. But I still couldn't get into a violin. Eventually, I teamed up with [a medical device maker] who lent me a couple of endoscopes. It took me about a year to figure out how to use them in a way that I could get these high-resolution photos."

Initially, the instruments Charles photographed were from trusting friends, and the first image he had any success with was of a cello made in 1780. It was in a state of disrepair and being restored by a mate who was a luthier – a craftsman who makes and repairs stringed instruments. "I started a website and posted that image, thinking I might sell five or six prints, and I published it on Reddit," Charles recalls. "Within a couple of days there were thousands of people looking, and it was crazy."

From that shoot he produced a series of images that, Charles estimates, were ultimately reproduced some 20 million times across newspapers and magazines, making it one of the most published art photo series ever. German newspaper *Die Zeit* ran one of Charles's photos and an accompanying story weekly for six weeks. It was, he estimated, editorial coverage worth the equivalent of millions of dollars' worth of advertising. So,

PHOTO CREDIT: NICOLE REED

The brass inside this century-old saxophone (right) shows oxidisation from thousands of hours of musicians' breath. Photo credit: Charles Brooks

Charles (below left) has perfected a unique way of capturing interior perspectives of musical intruments.

he made this very niche form of photography his career and hasn't looked back. "I never expected it to be this popular, and now I keep finding new instruments. Everything's interesting. Everything's exciting. It's always something new – I very rarely find an instrument that's boring," he says.

"It's an important part of the documentation that's missing for most instruments," Rainer says. He adds, however, that, as a luthier, the views don't tell him much that he isn't already aware of, because most valuable instruments can now be investigated using CT scans and other modern technologies. "Until about 40 years ago, there wasn't much public information about any old violins. That was held in certain elite violin shops," he continues. "Now there has been a complete explosion of information out there – varnish analysis and tonal analysis, all these sorts of things. But this [Charles's work] is more visual – it's such a beautiful thing."

To date, Charles says, one of the most surprising instruments he's shot has been a yidaki – a didgeridoo. "I was expecting to see a rustic instrument that had been chiselled out. But instead, I'm presented with this extraordinary organic structure, because, of course, they're [deliberately encouraged to be] eaten out by termites," Charles says. "Inside, it feels like a cave, and then you've got this red ochre running down from the wax in the mouthpiece that kind of bleeds into the instrument. You end up with a black-and-red tunnel that terminates with bright lights, and it looks like a nebula – like it's out of the world of astrophotography, which is another big passion of mine."

Then there are the images he has taken from inside a bassoon owned by early 20th-century global operatic superstar Dame Nellie Melba (see *The memory of Melba*, AG 186) – historically fascinating because of its influence on all classical music in this country. "She didn't play it, but she brought a pair of them over to Australia when she started out," Charles says. He explains that, back then, Aussie orchestras were essentially concert bands that played at a pitch that was higher than what Nellie and most other opera singers were comfortable with. "That meant she couldn't sing opera in Australia, because the instruments were all tuned too high. So, she pushed in the early 1900s to standardise Australian orchestras with the rest of the world by bringing these instruments over from Europe. This is one of them, and it worked."

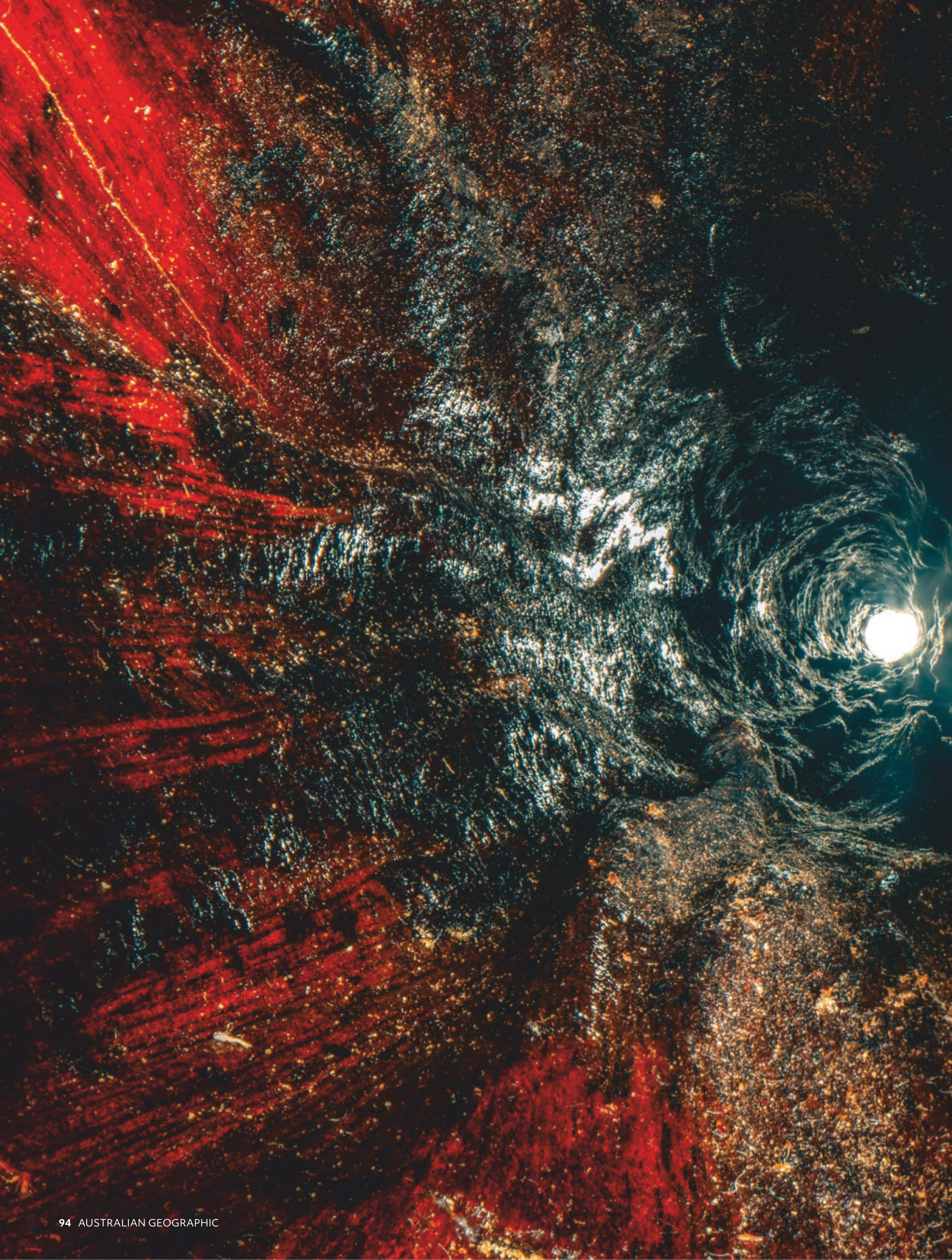
SO, A STRAD has been on Charles's bucket list since he began this newfound specialist career. And now there's one here, in the protective company of Daniel Dodds, artistic director of Festival Strings Lucerne, in Switzerland, and one of Australia's most acclaimed orchestral violinists. Dan is back home temporarily with the loaned Strad for a series of concerts including two with the Australian World Orchestra. The orchestra is occasionally pulled together, like an all-star sports team, from Australia's most elite musicians, many of whom return from positions in overseas orchestras to play for a limited concert series.

Rainer has also brought along one of his modern instruments, made in 2024, to be photographed. And local violinist Wilma Smith, who has performed all over the world and now plays with the Flinders Quartet, has also brought along her own 1761 Guadagnini – not quite as famed as a Strad, but almost as feted.

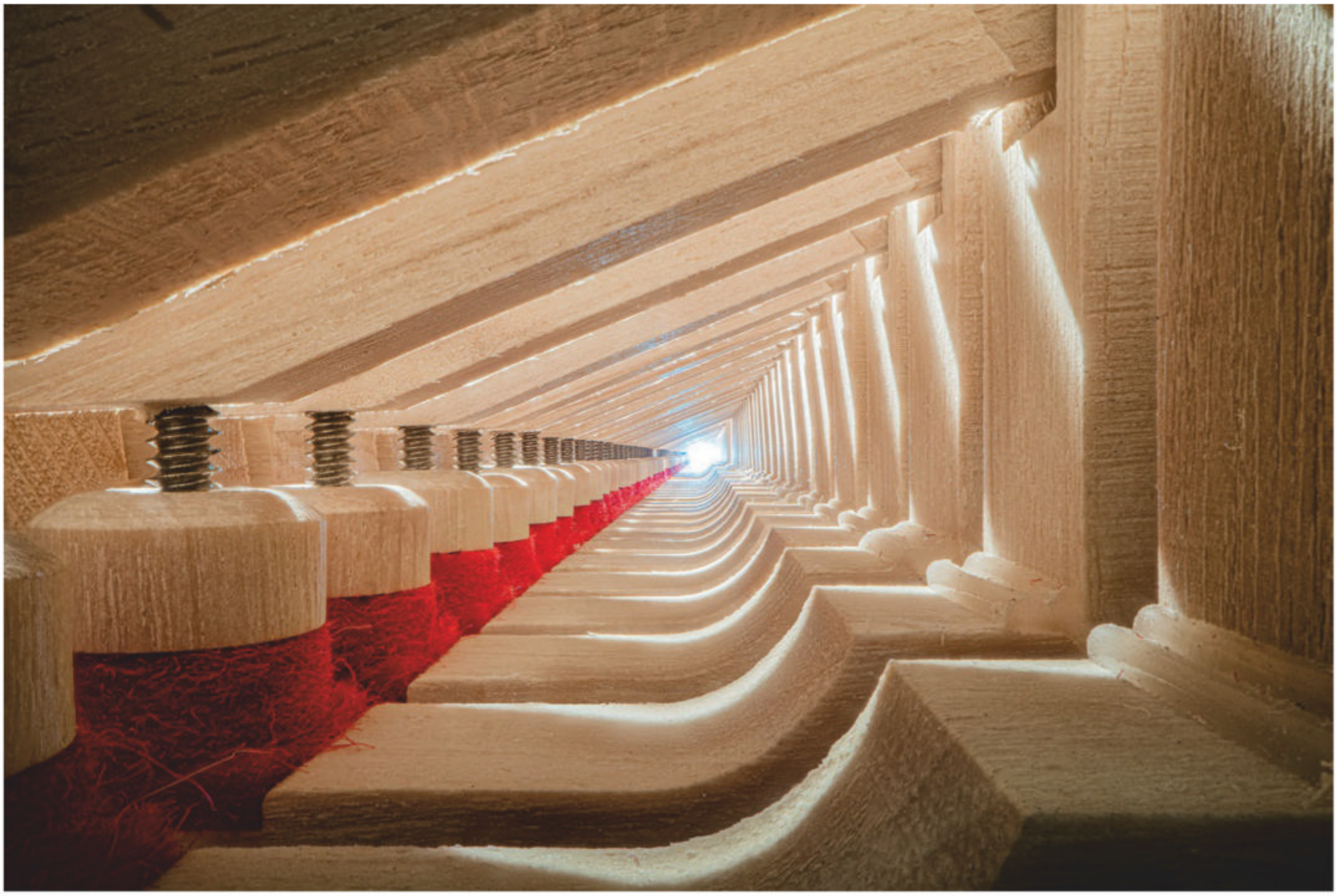
"I've been very lucky to play this violin for 40 years now and I know its history directly back to 1919," says Wilma, who will also perform with her Guadagnini at the Australian World Orchestra series. "It was bought from Charles Beare's London violin shop by a man called John Lawson, for £400. And I've got the original receipt, so it's certified as a genuine Guadagnini.

"John Lawson was a well-known violinist in Manchester. His son Eric, who also played, inherited this violin and came to New Zealand with his wife for a job as deputy leader of the New Zealand Symphony Orchestra." Wilma, who was then living in Boston, met Eric when he was about 80 and played the Guadagnini briefly. Months later, Eric decided he'd like Wilma to be the next owner of the violin and offered it to her for a fraction of its market value at the time. When Wilma returned to New Zealand to found the New Zealand String Quartet, she visited Eric regularly and they played duets until his death. Of course, she played the Guadagnini at his funeral.

Continued page 96 ▶



The patterns inside a yidaki (a didgeridoo) have been created by termites, which hollow out the instrument by eating away the wood.
Photo credit: Charles Brooks



On the shoot, it takes at least two hours of work by Charles for each instrument after it's been gently cleaned and minimally prepared. Then there's many more hours in post-production using tech Charles has sourced from Ukraine to stitch together multiple images taken at different resolutions. "I don't think I'd be able to do this without the patience I picked up from playing cello and doing all that practice," Charles says. "This is very slow, very repetitive, methodical stuff. It feels like I'm at home practising my scales. It's kind of meditative. There are definitely things I've adapted from other forms of photography, but there are things from my years playing the cello that help me take these photos."

What do you see inside these instruments? "Sometimes you see the chisel marks of the original maker, especially in places like the corner blocks. And so, you feel a closer connection to the luthier from the inside than the outside, which is polished to perfection – which is wonderful. But inside, you see the history. You see the repairs," Charles says.

So far, Charles says, every instrument has been different once he gets to see inside them, and none has ever disappointed. "I once photographed a saxophone that was just over 100 years old, and the inside of it was this incredible place where the brass had gone green – not because it wasn't clean, but [because] it was just oxidised from playing. And what I really loved is that the oxidisation was from thousands of hours of musicians' breath going through that instrument. Every practice session, every concert had fused and changed this instrument at a molecular level, and that was baked into its history.

"It's the same when we go into these instruments," Charles continues, pointing to the Strad and the other violins being photographed today. "These are so meticulously kept on the outside. Every repair is hidden, and everything is polished to perfection. And there are good reasons for that, but you also feel like you kind of lose the history. But when you see it inside, you're seeing the hand marks of the original maker. You're seeing repairs and changes from over the centuries. You're seeing, in Wilma's case, mysterious marks. To me, it's not just about observation. It's about legacy. And I find that very exciting." ■

This image inside a Fazioli grand piano (above) shows the precision handiwork of the luthier who made it. Photo credit: Charles Brooks

Charles Brooks (below, on left) is joined by violin-maker Rainer Beilharz (centre) and violinist Daniel Dodds (right) at a Melbourne studio as he prepares to photograph the inside of a Stradivarius violin.

The Australian World Orchestra will perform concerts at Melbourne Arts Centre on 3 September and the Sydney Opera House on 4 September. ***More info:*** *australianworldorchestra.com.au/whats-on*

PHOTO CREDIT, BOTTOM: NICOLE REED

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GREEN IS THE NEW BLACK

STORY BY **CLARE WATSON**
PHOTOGRAPHY BY **STEPHANIE SIMCOX**

After more than a century of mining coal to produce steel, the port city of Wollongong is reshaping itself as a clean-energy hub.

Bald Hill lookout in Stanwell Tops offers stunning views of the Illawarra escarpment's steep, verdant slopes – beneath which lie the coal seams that have fuelled the region's industrial legacy.

THE ILLAWARRA ESCARPMENT never strays far from the sea in Wollongong, an industrial port city directly south of Sydney. Save for the bulge of Lake Illawarra, rainforested cliffs threaded with rich, black metallurgical coal seams run beside a shimmering ocean dotted with cargo ships – and possibly wind turbines, if plans materialise.

Side by side, the city's coal and steelmaking past – still key to the local economy today – butts up against visions of its clean-energy future. And squeezed in between is a community of innovators, problem-solvers and skilled workers trying to find their place.

As I chat to actor-cum-climate-campaigner Yael Stone (see *Australian Portrait*, page 36) on a baking-hot February day, a train rattles past, injecting itself into our conversation. It knocks along a railway built in the 1880s to carry coal to Port Kembla, once Wollongong's industrial heartland and still New South Wales' second-largest port for coal exports.

"We've got a really potent potential workforce here for renewables, and we can't disregard [their] industrial knowledge," says Yael, who created Hi Neighbour, a not-for-profit helping local workers upskill for jobs in the fast-expanding renewables sector. "We can't forget these folks, this region, that have powered our country in traditional ways."

It's a familiar challenge for Australia – establishing new industries in communities built around coal – but one that's proving more complicated in the Illawarra than in other transitioning regions.

In early 2023, the Illawarra, seen as a key site for offshore wind development, was declared NSW's fifth renewable energy zone and one of three hydrogen technology hubs. But according to Dr Chantel Carr, a human geographer from the University of Wollongong's (UOW) School of Social Sciences, the region risks being left out of the national conversation about Australia's clean-energy transition because a different type of coal is mined here – one that's used for making steel, not generating electricity.

And yet locals know the Illawarra holds huge potential. In fact, it could be the source of some of the most crucial solutions to climate change. A groundswell of community-led action has, for example, given rise to Electrify 2515 (see page 109), a world-first pilot that's testing what happens when 500 homes in one suburb go fully electric.

A trio of startups borne out of industry know-how and university research are also making strides. UOW spin-off company Hysata has developed a super-efficient device for making green hydrogen from water using renewable electricity. Wollongong-based Sicona Battery Technologies has produced battery materials that could give electric cars one-third more range. And the third startup, Green Gravity, is devising a system for storing renewable energy in disused mineshafts across the Illawarra escarpment.

Meanwhile, BlueScope Steel, the largest steel manufacturer in the country, has just launched a project to figure out how to produce iron for steelmaking without burning coal.

"All of that [has] happened within a 5-to-10km [radius] here in the Illawarra," says Ty Christopher, an electrical engineer and director of UOW's Energy Futures Network.

Ty was born and raised in the Illawarra's northern suburbs. "As a region, we're right at the core of innovation, right at the core of people taking action on climate change," he says. "We also have this tremendous grassroots campaign of people caring deeply about the beautiful environment in which they live, caring deeply about the future of our region, our country and our planet, and asking themselves, 'What can I do about that?'"

On the other hand, community division around the planned offshore wind zone has seeded uncertainty. The federal government approved the zone in June 2024 – the fourth of six Australia-wide – but reduced its size by a third of what was originally proposed and moved it 10km further out to sea. Project developers have quietly dropped their plans, although they cite the region's deep water and wind speeds as technical challenges.

In Ty's view, it shows the energy transition now well underway in Australia – and around the world – is primarily a social transformation, not a technological one. "The reality is, all

Coal workers can slot into about half the jobs that make up the growing renewables workforce.

The Port Kembla Steelworks sits right alongside the beach in Wollongong. Stockpiles of coal can be seen here above the breaking waves.

of the tech to get us to net zero is available now," he says. "The challenge for us is: how do we engage with it as individuals, as communities, and as a nation to get us there in a way that's inclusive, that brings everyone along on the journey?"

The Illawarra is tackling these questions and providing answers that could light the path forward for Australia.

BRINGING THE WHOLE community along for the clean-energy transition is at the core of Hi Neighbour's mission. "We have to imagine our future in a way that includes our past," Yael says. "There's this real pride [in the Illawarra] around an industry that has been deeply formative for our community. It runs very deep."

Darryl Best speaks proudly of his career in coalmining, even though he regrets its impact on the environment. Moving from Lithgow to the Illawarra after his electrical apprenticeship as a young man, Darryl ran a crew at Dendrobium coalmine and later was appointed undermanager at Wongawilli colliery.

"I always tried to put myself in the workers' shoes," says the retiree and Hi Neighbour board member who advocates for renewables jobs in coal communities. "I'm working as hard as I can."

Darryl knows firsthand what happens when coalmines shut abruptly with no transition plan for workers. When Wongawilli closed in 2014, he was the manager who had to tell more than 100 miners they were out of work. "People lost their sense of worth," he says. "They lost their ability to be part of the community they live in."

Another local coalmine closed in the Illawarra last year due to safety concerns. But coal workers, Darryl says, are adaptable, skilled at problem-solving, and incredibly safety-conscious because they work in hazardous environments with fast-moving machinery. With those skills and a bit of training, he says coal workers can slot into about half the jobs that make up the growing renewables workforce.

But Chantel – who began her career as an industrial electrician at the Port Kembla Steelworks and now studies the social and workforce dimensions of energy transitions – says that while some industrial skills can be easily transferred, shifting sectors isn't always straightforward. One coal sector worker ►

lamented to her: "I've spent the last two years working towards my [engineering] degree, and unfortunately…as much as I would like to move out of the industry, this is where my experience is."

Many coalminers, especially those nearing the end of lifelong careers, also feel attacked by accusations their industry is ruining the climate. "Everyone is saying their industry is rubbish and you've got to shut [the coalmines] down," Darryl says. "So, of course they're going to rally against this. [Coalmining] is tied up with who they are."

However, younger workers are heralding a new generation looking to renewables. Take Josh Smede, a Hi Neighbour scholarship recipient and third-generation electrician whose grandfather worked in the coalmines, for example. He now gets 80 per cent of his work from solar and battery installations.

To keep pace with the demand for renewables, modelling suggests Australia's electricity workforce needs to double in the next five years to meet the country's 2030 target of 82 per cent renewables in our electricity grids. So, Hi Neighbour is also supporting high-voltage industrial electricians such as Endeavour Energy apprentice Claire O'Shea (see page 106), who maintains and upgrades substations, as well as engineers, environmental assessors and project managers who are in demand amid skills shortages. Claire's TAFE class, she says, is full of people wanting to go into solar and wind: "It's a very popular thing that people are wanting to do."

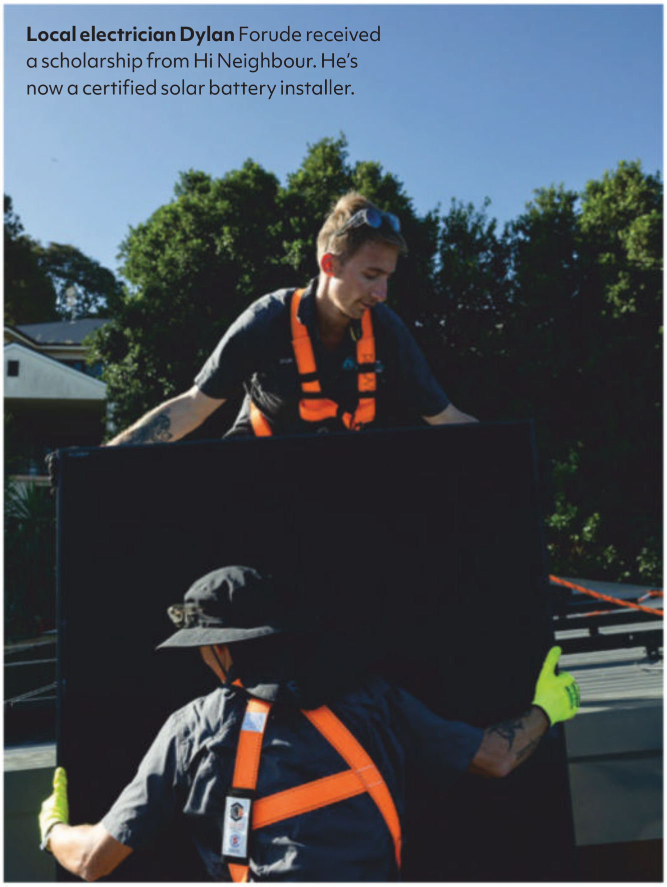
THE JOBS BOOM promised by large-scale renewables projects isn't necessarily translating into jobs on the ground in the Illawarra just yet, though. Darryl says the lack of real job opportunities – save for a handful of local startups employing fewer than 150 people – makes it hard to convince career-long coal workers to retrain. "We've just been forgotten down here," Darryl says. "Coalminers will say to me, 'Transition into what or where? There's nothing here.'"

Chantel again points to the fact that a different type of coal is mined in the region. "The issue that we have here in the Illawarra is that we're not really on the radar because we're not part of the conversation around thermal coal," she says.

Thermal coal is burnt to generate electricity, whereas the Illawarra escarpment's metallurgical (coking) coal is used for steelmaking. In fact, for the 3.2 million tonnes of raw steel BlueScope (formerly BHP Steel) makes annually at its Port Kembla Steelworks, about 80 per cent of the metallurgical coal it requires comes from the Illawarra. Australia's domestic demand for thermal coal is tapering off with the rise of renewables, but metallurgical coal exports are peaking. "[The Illawarra is] on an entirely different trajectory to the likes of the Hunter, Gippsland, Central Queensland," Chantel says. "[Illawarra coal workers] have only known a rapidly expanding export sector for the last decade and a half. So this talk of energy transitions doesn't match their experience at all, which is a real problem."

That trajectory will shift. Demand for metallurgical coal exports will decline as global steelmakers decarbonise by shifting away from coal-fired blast furnaces and adopting low-emissions technologies instead. For now, however, renewables remain a hard sell to local coal workers.

Another factor is that the Illawarra's economy has been forced to diversify amid industrial layoffs and rising unemployment. In 1966, one in four men in the region was employed in steel, and some 44 per cent of the region's workforce was employed in mining or manufacturing. Today, manufacturing makes up just 7.4 per cent, and mining only 1.8 per cent. Healthcare and education are now the largest employers.


Local electrician Dylan Forude received a scholarship from Hi Neighbour. He's now a certified solar battery installer.

"No one technology is going to solve our clean-energy future."

Since the 1960s, BlueScope's Port Kembla Steelworks has been the largest in Australia. It still employs some 3500 people and is one of the Illawarra's biggest emitters. Decarbonising the steelworks will require up to 15 times more electricity than it currently uses – equivalent to the daily usage of 900,000 households. That demand can't be met by rooftop solar, and the region's geography limits space for solar farms, so large industries such as steel need the scale and reliability of offshore wind.

"No one technology is going to solve our clean-energy future," Ty says. "But the right combination of most, if not all of them, will get us the clean-energy future we need."

His calculations show the 2.9-gigawatt offshore wind zone planned for the Illawarra could generate more than double the region's future energy demand, with the surplus helping to decarbonise industry or make green hydrogen. Locals would also benefit from cleaner air. But opposition to offshore wind has been fierce. Illawarra's offshore wind zone drew 14,211 submissions – 5,305 more than the other five zones combined. About 65 per cent of submissions opposed the zone, though other local and national surveys indicate support is higher than submissions suggest.

The extent of community opposition was striking. "[It] came as a surprise to a lot of people," says Natasha Larkin, a legal geographer whose PhD thesis at UOW examined the legal frameworks for offshore wind in Australia. After poring over submissions and attending fiery public meetings, Natasha traced the opposition back to several overlooked regional factors. "People didn't buy the narrative that this would be good for jobs," she says. Supporters and opposers alike expressed concern that environmental assessments are deferred until after a zone is declared and placed in the hands of project developers. "If developers are just looking at their individual project," she continues, "then we're not looking at the cumulative impacts across an area."

Chantel points out that the Illawarra also has more technicians and trades workers than the national average – residents with a deep understanding of what the new industry might entail, and who are scrutinising proposals closely. "They were looking to the specifics of what's being proposed and wanting more information," she says, adding that there's also a wariness of large industrial players who haven't always done right by people or the environment. "That history [of industrial relations] can drive scepticism."

Although the Illawarra's offshore wind future hangs in the balance, Natasha views the process so far as constructive. "It brought out a lot of important issues that needed to be aired," she says. "The questions people were asking as a community showed a great deal of insight and knowledge, and a deep connection to this place that ought not be dismissed."

WHILE DEBATES ABOUT offshore wind roll on, BlueScope is figuring out other ways to decarbonise its steelmaking processes. Its carbon footprint per tonne of steel produced is down 12 per cent since 2018, helped largely by reductions at its steelmaking plant in Ohio, USA, which uses abundant scrap steel to lower emissions. Port Kembla, with its coking coal and traditional blast furnaces, is a different pot of steel.

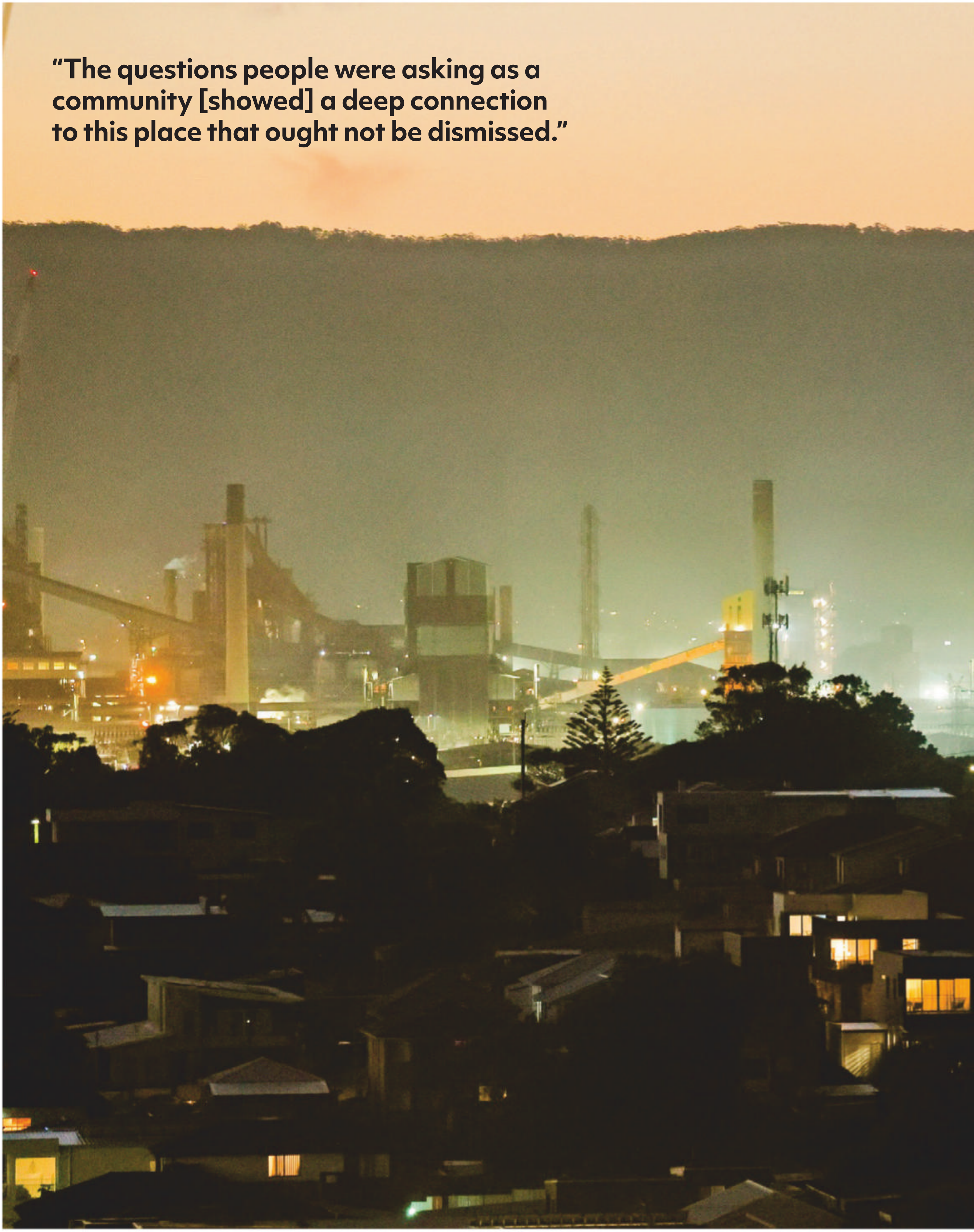
Driving through the steelworks on a public tour, we pass two hot metal ladles parked up on the rail line. The heat shimmers off the molten iron contained inside these torpedo-shaped carts. Behind, the No. 5 blast furnace continues to burn super-heated coking coal to smelt iron ore and extract the molten iron, which is carted off and made into steel. It's this molten iron that BlueScope needs to make 'green' if the company is going to decarbonise its steelmaking.

That's where a newly launched pilot project comes in. Called NeoSmelt, the pilot is testing whether BlueScope can do away with coal and traditional blast furnaces, and instead make molten iron using hydrogen and an electric smelting furnace. BlueScope plans to use green hydrogen (made using renewable electricity) to convert iron ore into molten iron. But until

Continued page 106 ►

Dr Chantel Carr says demand for the type of coal produced in the Illawarra is still high – which makes talk of renewables a tougher sell to local coal workers.

“The questions people were asking as a community [showed] a deep connection to this place that ought not be dismissed.”



BlueScope's Port Kembla Steelworks needs the scale and reliability of offshore wind to help meet its decarbonisation targets.

PHOTO: CHEL [illegible]

Natasha Larkin's PhD research charted Australia's emerging offshore wind industry and questioned whether the promise of local jobs would be realised.

the economics tip in green hydrogen's favour, the company will use natural gas, a fossil fuel that contains hydrogen locked up in methane. "This is a fairly substantial pilot," BlueScope's Chief Executive of Australian Steel Products, Tania Archibald, said in January when announcing the NeoSmelt plant would be located in Kwinana, Western Australia, closer to the Pilbara iron ores BlueScope plans to use.

The plant, once operational in 2028, could produce 30,000–40,000 tonnes of molten iron per year. But that's less than 1 per cent of BlueScope's annual iron supplies. The company uses as much molten iron as the NeoSmelt plant could produce in a year in just 4–5 days at its Port Kembla Steelworks.

However, about 70 per cent of the world's steel is made using iron from blast furnaces, so eliminating those coal-fired processes with NeoSmelt technology could slash steelmaking emissions not just in the Illawarra but also around the world. "What we're hoping," Archibald said at the announcement, "is that we can then effectively skip a step and go straight [from the pilot stage] to full commercial scale so it really helps accelerate the decarbonisation of steelmaking."

The pilot will run for 3–5 years. But first, BlueScope – in partnership with its collaborators, mining giants Rio Tinto, BHP and Woodside Energy – needs to build the NeoSmelt plant from scratch. And the processes for making so-called green iron from Pilbara iron ores using renewable electricity are yet to be developed. "The challenge is going from creating a bucket of the stuff in the lab to creating multi-hundred-tonne ladles of it in a factory," Ty says.

Until then, BlueScope is stuck with traditional ways of making iron at its Port Kembla Steelworks and is spending $1.15 billion to replace the worn-out inner brick lining of its No. 6 blast furnace so that it can operate for another 20 years.

In the meantime, BlueScope is trialling alternative methods to cut emissions, including using more scrap and exploring new

CLAIRE O'SHEA
HI NEIGHBOUR SCHOLARSHIP RECIPIENT

Apprentice electrician Claire O'Shea (right) works on a part of the electricity grid people rarely stop to appreciate: substations. These fenced-off buildings dotted through suburbia are a crucial link in our national electricity grid, converting high-voltage electricity into lower voltages suitable for household appliances and lights.

But our electricity grid is changing with the influx of renewables, so these decades-old substations need upgrading to flexibly control the flow of electricity generated from our changing energy mix – more solar, wind, batteries and hydropower, and less coal and gas.

"When a bunch of new equipment comes in…it's exciting to see how it all operates," says Claire, a second-year apprentice with Endeavour Energy. "I love working on older equipment. You see how it compares to new stuff and how much easier, more efficient things are now."

While Claire is training as an industrial electrician, she's open-minded about where her career could take her and sees opportunities in offshore wind if it finds a footing in the Illawarra. "It'll be interesting to see what opportunities arise," she says. "I'd definitely love to [experience] a different side of industry and work on something that has more of a [positive] impact."

Liquid iron is blasted by high-speed oxygen and converted into steel at BlueScope's Basic Oxygen Steelmaking facility.

Already, as a country, we've crossed the electrification tipping point.

carbon sources and hydrogen technologies. It has also trialled a CSIRO electrolyser that uses industrial waste heat to make green hydrogen with less power. But BlueScope's decarbonisation plans all depend on having a stable supply of renewable electricity.

THE NEXT STOP on the steelworks tour is an old warehouse BlueScope has leased to local startup Green Gravity. As we pile off the bus, we hear something whirring; inside the old foundry, the startup has built a 12m-high prototype of its gravity-based energy storage system. It works by hoisting weights using excess renewable energy from the grid and lowers them to dispatch power on demand, using regenerative braking, as in an electric car, to convert the weights' motion into electricity.

The idea is to build much bigger versions of this prototype in abandoned mineshafts that plunge several hundred metres deep into the Illawarra escarpment. "Any mine that's no longer in use, we can turn into energy storage," says Tania Jones, sustainable market development manager at Green Gravity (see page 108). "The more systems we have, the more power we can generate."

Made of shiny new steel, the Green Gravity structure gleams against the red-tinged frame of the old foundry. The technology, if deployed, would help the grid handle more renewables, functioning like a battery but with virtually endless 'charge-discharge' cycles. By Green Gravity's calculations, installing the system in just one local mineshaft could power about 3000 homes – one suburb in the Illawarra – through the night by storing surplus solar energy from their rooftops.

With 37 old mineshafts mapped out across the Illawarra, the potential capacity is huge. These sites are already grid-connected, the land is already disturbed and needs rehabilitating, and the local workforce has the skills that Green Gravity needs to plan, design, build, wire up, monitor and maintain their systems.

"Once the system is up and running, we'll also need a lot of data analysts and mechatronics specialists," Tania says. "Electricity is real-time. Understanding what the grid's requirements are, the demand and the supply, when to switch [the system] on and off – there's a lot of data collection, simulation and computer programming associated with this. And that opens up whole new career pathways for the community that perhaps didn't exist before."

Green Gravity has, however, taken heed of the community division around offshore wind in the Illawarra. The startup – which Tania says is on track to build its first demonstration plant in a local mineshaft by the end of 2025 – is taking a more considered approach, inviting people to tour their warehouse to size up the prototype technology for themselves.

"What I'm seeing is that for us to make this energy transition, it needs to be very grassroots and community-driven," says Tania, whose grandparents emigrated from Malta in the ►

GRAVITY LAB

Wollongong locals observe Green Gravity's 12m-high prototype, which is designed to transform disused mineshafts into large renewable-energy storage systems.

TANIA JONES
GREEN GRAVITY

A former mining executive and the granddaughter of Maltese migrants who worked in the steelworks, Tania now leads community engagement at Green Gravity – a local startup developing gravity-based energy storage systems.

Built in an old foundry at the Port Kembla Steelworks, the startup's 12m-high prototype hoists heavy weights using excess renewable energy, then lowers them to generate electricity when needed. The system is designed to store solar energy during the day and release it at night, helping to stabilise the grid.

Green Gravity estimates that installing the technology in a single disused mineshaft could power up to 3000 homes. With 37 shafts mapped across the Illawarra escarpment, the potential is significant.

Tania runs monthly tours to teach the public about the technology – and earn their trust. "While jobs are good, they may not be the priority for some of the communities we're working in," she says, explaining that energy prices, grid reliability or rehabilitating disturbed land might be bigger concerns.

She sees Wollongong's deep skills in manufacturing, mining and engineering as major assets. "It's about building trust and understanding what's important to the community; sharing information and inviting questions," she says. "The community [needs to] feel like they have control over what's happening."

mid-1940s and were employed in the steelworks. For Green Gravity, that means building operations using the skills and experience of Wollongong locals – and getting the community onside. "You need to meet the community where they're at and understand what's important to them," she says.

ONE-THIRD OF AUSTRALIAN homes now have solar panels, which means some 4 million houses are feeding excess electricity into the grid (if they don't have their own battery for storage). Collectively, solar-powered households generate more electricity for our national grid than large solar farms, wind or gas.

"Australians are leading the world in energy transformation," Ty says. But that also means we're navigating uncharted territory. "We don't have somewhere else to look to say, 'They're ahead of us on this journey; there's a proven pathway forward.'"

That's why Electrify 2515, a community-led project in northern Illawarra masterminded by local engineer and innovator Dr Saul Griffith, is so exciting. "It's a way to jump 10 years into the future and prove how to do this – not in a lab, not in a spreadsheet, but in real life," Ty says.

The pilot project was launched late last year, backed by $5.4 million in federal funding to help 500 households in the 2515 postcode – which includes the Illawarra suburbs of Austinmer, Clifton, Coledale, Scarborough, Thirroul and Wombarra – to buy home batteries and switch from gas to all-electric appliances. The subsidies will be scaled for income, and the pilot will also measure economic benefits to the community if household savings on energy bills flow into local businesses.

DR SAUL GRIFFITH
ELECTRIFY 2515

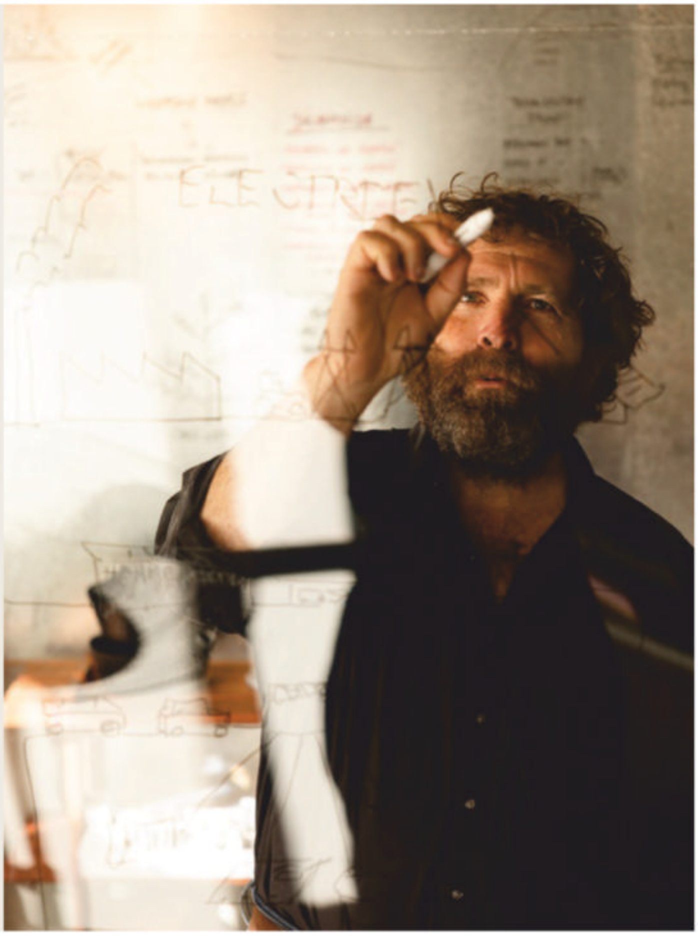
The slogan 'Reduce, reuse, recycle' sounds to Dr Saul Griffith (right) like a call for 'colder, less and fewer'. To his innovator's mind, an all-electric future promises abundance and prosperity that "could amount to the biggest economic boon to Australian communities we've ever seen".

By his calculations, Saul's 2515 postcode of some 4700 homes could easily generate half of all its energy needs with rooftop solar and save $16–20 million on energy annually once fully electric. Plus, they would enjoy cleaner air and healthier homes.

"I'm kind of sick of the 'we're gonna efficiency our way to the future [approach]'," Saul says. "Why can't we ride into the future on an electric jetski? That flies a bit in the face of your typical environmentalist, but I think we need to have more fun."

His dusty workshop embodies this outlook. It's filled with inventions: go-karts built with local kids, a solar scooter, and a 1966 Vespa he's electrifying with his son. Screws and parts cover a ping-pong table.

Whether it's these projects or Electrify 2515, Saul wants people to see "how awesome the future can be". Decisions made at home – what you drive, how you cook, how you heat your water and your home – account for one-third of Australia's domestic carbon emissions. "We really can do this," he says.



More than 600 people packed Anita's Theatre in Thirroul on a sunny Sunday afternoon in November for the pilot launch, and Saul confessed to his neighbours he was nervous. "I'm used to running experiments on the machines," he told the crowd. "This is an experiment I'm running on my community."

But the community is game. More than 250 households applied to be part of the pilot in its first month. On top of financial support to electrify their homes, participants will also receive a smart energy device to track and optimise their household energy use. Project partner Endeavour Energy will monitor electrical loads across the suburb, and Saul hopes the data will show electrifying most homes isn't going to break the grid but make it more reliable.

It's early days, but Saul – an architect of the largest piece of climate legislation in US history, the US *Inflation Reduction Act* – lights up when I ask him about the Electrify 2515 launch a few months after the event. "[It felt] a bit historic," he says. "Climate action has [until recently] either been large-scale public protest or very wonky policy stuff like carbon tax debates."

Electrify 2515, he says, is different because it's community-led. "[We are] engaging in genuine on-the-ground climate action and figuring out how to do it together. It isn't really happening anywhere else in the world quite like that."

As momentum builds around the project, federal Minister for Climate Change and Energy, Chris Bowen, has directed the Australian Renewable Energy Agency to consider funding other community electrification pilots nationwide.

In years to come, Saul hopes we might look back and see Electrify 2515 as "the first bolthole where we proved that the future could work". Already, as a country, we've crossed the electrification tipping point, according to Saul's latest analysis with Rewiring Australia, a non-profit organisation he co-founded. Going electric is now the cheapest way to do everything: to heat your house, to heat your hot water, to drive, and to buy electricity. Even including upfront purchasing costs, fully electric households with solar and batteries could save about $4100 per year, the modelling shows. "Economically, this is a no-brainer," Saul says.

But even more meaningful than those numbers are the one-on-one conversations around 2515 that Saul has when he swims with septuagenarians in rock pools and is peppered with questions about hot-water systems and electric vehicles (EVs) at his local coffee shop. Those conversations build trust, which Saul says is the key ingredient needed for the energy transition. It's how solar panels were sold so successfully in Australia. "Over the back fence," Saul says. Neighbour to neighbour.

"I was swimming the other day," Saul adds, "and an old guy stops me." He was a retiree, a former fitter and turner at Port Kembla, who admitted he didn't initially believe Saul's assertion that it was cheaper to heat his home with solar. But the retiree had done a spreadsheet, and now declared to Saul: "It's true: I'm gonna save $1600 this year. So I've decided to do the whole house now. It's going to be all-electric. The wife loves it."

"Here is this rust-coated-on-him, heavy-industry guy," Saul says. "He tells his mates…" Saul trails off, pausing to take it all in. "I mean, that feels like a very positive social change you can believe in." ■

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Shielded from light pollution, the stunning night sky is a major drawcard for the town of Tekapo on New Zealand's South Island. But the area also has many other attractions, including the historic Church of the Good Shepherd on the shores of Lake Tekapo.

PHOTO CREDIT: RACHEL GILLESPIE

A combination of natural attributes and lighting regulations make the night skies above New Zealand's Mackenzie Region some of the clearest in the world.

DARK SKY DELIGHT

STORY BY **CANDICE MARSHALL**

The Southern Hemisphere's largest Dark Sky Reserve will make you feel small – in the best way possible.

IT'S LATE EVENING and I'm travelling in a small bus, surrounded by complete darkness. Even the vehicle's headlights are turned off as the driver navigates an unsealed road winding up the side of a mountain. It's unnerving, but he obviously knows what he's doing and has done it many times before.

But why would the headlights be turned off in such a seemingly precarious situation? Because we don't want to emit any light pollution that would obscure the view of the night sky.

We're on our way to the University of Canterbury's astronomical research centre. Here, 1029m above sea level atop Mt John on New Zealand's South Island, the skies above are some of the clearest in the world. The area is officially recognised as a Dark Sky Reserve – the largest in the Southern Hemisphere.

Granted its status in 2012, the Aoraki Mackenzie International Dark Sky Reserve covers 4367sq.km and encompasses national parks, farming land, private and public land, and whole townships. Accreditation is bestowed by DarkSky International, the independent organisation that oversees the International Dark Sky Places program and provides certification to places – everything from large protected areas to communities, parks and urban locations – that "preserve and protect dark sites through responsible lighting policies and public education".

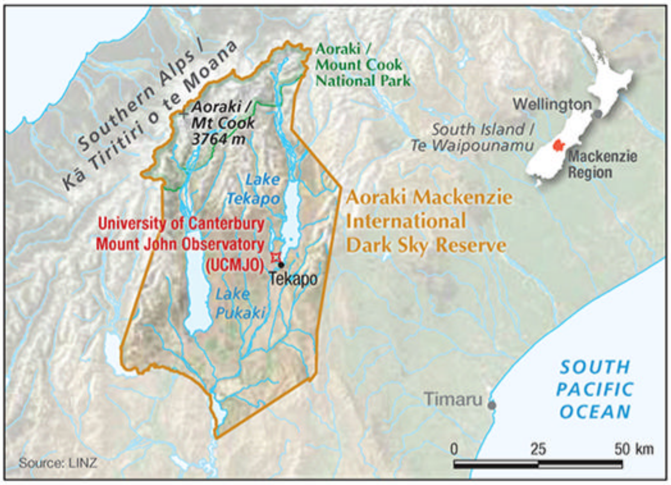
It's part of a wider movement to acknowledge the night sky and nocturnal environments as naturally, culturally and historically important – worthy of conservation.

AUSTRALIA HAS ITS own Dark Sky Places, including three in South Australia – Arkaroola Dark Sky Sanctuary, River Murray Dark Sky Reserve, and Carrickalinga Dark Sky Community. Elsewhere, there's the Jump-Up Dark-Sky Sanctuary in Queensland's Winton, and Warrumbungle Dark Sky Park in New South Wales (see *Let there be night*, page 72).

Back on the bus, the carpet of stars above is already putting on a spectacular show – and we haven't even officially started our stargazing experience yet. Each passenger has fallen silent, noses glued to the windows as a soundtrack of celestial-themed songs play over the speakers. Think Frank Sinatra's 'Fly Me to the Moon', Simply Red's 'Stars', The Beatles' 'Across the Universe', Elton John's 'Rocket Man', Madonna's 'Lucky Star', and of course, David Bowie's 'Starman'. This might sound quite contrived, or even a little naff (and it kind of is!), but when Moby's 'We Are All Made of Stars' comes on, I'm completely sucked in.

People, they come together
People, they fall apart
No one can stop us now
'Cause we are all made of stars

These lyrics remind me of something that happened earlier in the day. Turn back the clock several hours and I'd just arrived at the Dark Sky Project headquarters on the shorefront of Lake Tekapo. Tekapo is the tourism hub of the region and the most popular base for visitors embarking on the area's 'astro adventures' – of which there are plenty. ►



Source: LINZ

PHOTO CREDITS: COURTESY MACKENZIE REGION NZ

The location of the University of Canterbury Mt John Observatory was chosen for its unobstructed 360° views of pure night sky.

The biggest player in town is the Dark Sky Project, the first astrotourism operation in the area. It was founded in 2004 by Graeme Murray and Hide Ozawa – Tekapo locals who were also instrumental in acquiring the region's Dark Sky Reserve status.

Now co-owned by Ngāi Tahu Tourism – Ngāi Tahu being the largest iwi (Māori tribe) in Te Waipounamu (the South Island) – the Dark Sky Project offers experiences from both scientific and cultural perspectives. Its mission is to ignite a passion for the dark sky and invoke a concern for its preservation. Visitors learn about the importance of darkness to human health and the environment.

I'm here for the Dark Sky Experience – an indoor multimedia immersion allowing for night-sky exploration during the day. Bringing together Māori astronomy (*tātai aroraki*) and Western science, it's during this guided tour that our expert explains how every one of us in the room is made of stars – literally.

Essentially, the human body is mostly made up of elements that were formed by fusion in the cores of ancient stars. When these stars died, supernova explosions scattered the elements across the universe and, over billions of years, these elements combined in various ways to create new stars, planets, and eventually, life – meaning Earth, and everything on it, is made from those recycled star materials.

It's not just poetic. It's scientific.

This stayed in the forefront of my mind all afternoon. And while Moby's song is a metaphor for the interconnectedness between humans, hearing these lyrics while looking up at the night sky, in the context of what I had learned, caused me to feel an overwhelming connectedness to the stars themselves that I had never felt before.

"They say it takes a village to raise a child. We say it takes a village to protect the stars."

THE BUS HAS reached the summit, and we pour out onto the gravel car park. Mt John Observatory has been here since the 1960s, long before the concept of Dark Sky Reserves or the now-booming astrotourism industry.

"A survey of New Zealand was done, and Mt John was [found to be] the most favourable site," says Steve Butler, chair of the Aoraki Mackenzie International Dark Sky Reserve.

Mt John is in the Mackenzie District of South Canterbury, where the area's natural attributes provide some of the clearest night skies in the world.

Steve explains the importance of the intermontane (between-mountains) plateau. "[It's] a glacial outwash enclosed by mountain ranges, and the alpine air environment provides a good weather pattern for astronomy," he says. "There are high levels of fully clear [completely cloudless] nights."

Because of this, measures have been taken to reduce human-caused light pollution that would compromise the area's natural dark skies.

The most obvious example is the design of streetlights. Bulbs are fully shielded by covers that direct the light downwards.

These covers are mandatory for all outdoor lights in the area – on both public and private property.

"The district plan states all new light fittings installed must be fully shielded, lighting only downwards and not upwards or to the side," Steve says.

Other lighting ordinances include limits on blue-light emissions. "The reason for that is that the blue portion of the lighting spectrum scatters very readily in the atmosphere and causes a big glow to form over a city or a town. It's the same reason the sky is blue in the daytime – the blue portion of the light in sunlight scatters more readily," Steve says.

An overwhelming majority of locals have welcomed these lighting regulations, eager to see their community benefit from the influx of visitors the dark skies bring.

"I think it's brilliant," Steve says. "Eighty-six per cent of the world's population can't see the night sky. So, there's a booming industry all around the world, and it's a tourism stream where there's very little impact."

The regulations protect the unobstructed, 360° view of pure night sky that's visible from Mt John – and which makes Dark Sky Project's Summit Experience so special.

OUR GUIDE TAKES us for a walk through the working observatory's buildings and domes, stopping along the way to share the science and stories of the constellations above. Then, it's time to venture deeper.

We use high-powered telescopes to focus on everything from the Milky Way to far-off star clusters, planets, whole solar systems and even distant galaxies, learning about each as we go. But the real treat is access to the University of Canterbury's 16-inch Schmidt-Cassegrain telescope, housed within its own fit-for-purpose private observatory dome.

Of all the mind-blowing celestial wonders we see, my favourite is the 'Jewel Box' cluster (officially named NGC 4755, if you want to get technical). Nestled within the Southern Cross constellation, this open star cluster is only about 16 million years old – quite youthful in stellar terms! About 6500 light-years away from Earth, this group of about 100 stars looks like a single star to the naked eye.

It's through the telescope that its striking colours become visible. With a mix of bright and faint stars, contrasts of pale blue and orange, and a solitary ruby-red supergiant at its heart, it's like peering into a jewel box.

When the experience comes to an end, we make our way back to the bus and I reflect on everything I've learned, seen and felt throughout the day.

The Dark Sky Project has a motto: "They say it takes a village to raise a child. We say it takes a village to protect the stars."

This is certainly true of Tekapo – a small, remote New Zealand community that has banded together to protect something that's bigger than all of us, but yet fundamentally part of us.

After all, we're all made of stars. ■

Candice travelled as a guest of Mackenzie Region NZ.
mackenzienz.com

PHOTO CREDITS: COURTESY MACKENZIE REGION NZ

Visitors relax in a hot pool during one of Tekapo Springs' Soak in the Stars stargazing tour

SEE THE STARS, YOUR WAY

SOAK
When the sun sets, Tekapo Springs transforms from its family-friendly hot pools into a relaxing oasis. Guests lie back on floating hammocks while a poolside guide tells the stories of the stars.
tekaposprings.co.nz

SNAP
Head to the hills and join a small-group astrophotography tour with Silver River Stargazing, whose guides help you create incredible photo memories of your Tekapo visit. To top it off, they also help guests post-process images, so you'll walk away with a masterpiece.
silverriverstargazing.com

SIP
Stargaze with a stiff drink in hand at Mt Cook Lakeside Retreat, where the intimate stargazing experience is accompanied by a nip of Scotch whisky in honour of the history of Scottish settlement in the area.
mtcookretreat.nz/stargazing

SNUGGLE
Chameleon Stargazing wraps up its tours by lighting a fire and passing around hot chocolate and marshmallows. It's a very cosy option and great for families.
chameleonstargazing.com

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- Hike Lizard Island and spot nesting turtles.
- Visit Stanley Island and see its Aboriginal rock art depicting European sailing ships.
- Stroll along the Secret Garden walking track on Fitzroy Island or hike to its lighthouse.
- Learn about the ocean's seafloor with bathymetrist Dr Robin Beaman.
- Watch sunsets on a remote sand cay.
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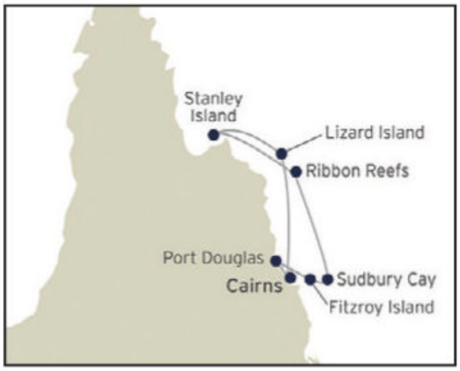
- Visit Forever Reef Project's coral ark – the world's first living coral biobank – with Dr Dean Miller, its founder.
- Receive an exclusive limited-edition commemorative jacket from Coral Expeditions.

PHOTO CREDIT: JUSTIN GILLIGAN/AUSTRALIAN GEOGRAPHIC



Discover ancient rock art on a hike of Stanley Island (below) and listen to engaging and informative lectures from expert guides (right) on this unforgettable citizen science tour.

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Longreach stands tall in the story of outback Queensland and remains a popular destination for travellers today.

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OUTBACK QUEENSLAND IS rich with tales of resilience, grit and spirit. In towns such as Cunnamulla, Charleville, Quilpie and Longreach, people endured scorching summers, droughts and isolation – yet they carved out a life from the red dirt.

These were tough men and women who built sheep and cattle stations, sank wells and raised families in some of Australia's harshest conditions. Their legacy lives on in the old homesteads, historic pubs and wide-open landscapes they once called home.

Step back in time on this unforgettable nine-day guided tour through outback Queensland, where you'll hear tales of bushrangers, boundary riders and station hands, and learn how their determination shaped the region's character. From the fertile plains of St George to the legendary shearers of Blackall and the birthplace of Qantas in Longreach, you'll uncover the rich legacy of our nation.

Explore remote stations, historic hotels and wool scours while enjoying warm country hospitality, gourmet local fare and authentic cultural encounters.

With engaging guides and unique experiences at every stop, this tour offers a deep, personal connection to Australia's rugged outback.

We're excited to give you a glimpse of just a few of the incredible stories you'll uncover on this journey.

The Cunnamulla Fella

The Cunnamulla Fella is a bronze statue honouring the iconic Aussie bushman made famous by a song from Slim Dusty and Stan Coster. Sitting proudly in Cunnamulla, he represents the tough, resilient spirit of the outback. With his hat, swagger and laid-back pose, he's a tribute to the hardworking people who helped shape rural Australia.

The pub without a town

Cobb & Co once connected the remote town of Toompine to the rest of Australia with its regular coach service. Today, the only surviving landmark from those days is the South Western Hotel (circa 1893). Small in size but big on character, this classic outback pub offers all the charm and charisma you'd expect from a true Aussie watering hole.

PHOTO CREDITS, THIS PAGE: TOURISM AND EVENTS QUEENSLAND; OPPOSITE: OUTBACK QUEENSLAND TOURISM ASSOCIATION

◀ Australian Stockman's Hall of Fame

This museum is a living tribute to the rugged identities who shaped Australia's outback. It celebrates the bravery, skill and resilience of stockmen, shearers and Indigenous Australians. The Hall honours the spirit of the outback, where courage and survival are intertwined.

▶ John Robert 'Jackie' Howe

Jackie was a legendary Australian sheep shearer famous for his incredible speed and endurance. In 1892 he set a world record by shearing 321 sheep in seven hours and 40 minutes with hand shears – a record that still hasn't been broken. Known for his strength and impressive skill, Jackie became a folk hero, symbolising the determination of Australia's rural workers.

HOWE
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FORD CARS
AND
SIGNAL LORRYS
J. HOWE

▼ Toogunna Plains Farmstay

Deep in the heart of the Channel Country between Quilpie and Eromanga, Toogunna Plains is a fifth-generation, 130,000-acre sheep and cattle station offering an authentic outback experience. Spend two nights in ensuited cabins, enjoy paddock-to-plate dining and embark on a guided station tour exploring abandoned homesteads, oil fields and shearing sheds. You'll also experience an exclusive sunset tour to nearby rolling, red Kyra Sandhills, where contrasting outback colours dazzle.

DEPARTURES & FARES

Duration: Nine days

Group Size: Maximum 12 people

Activity Level: Easy to Moderate

Departing:
- 24 May 2026
- 21 June 2026
- 16 August 2026
- 13 September 2026

Prices:
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HIGHLIGHTS

- Led by an Australian Geographic Travel specialist marine and nature conservation guide.
- Experience nature at its best on Heron Island, world-famous for its spectacular coral reef and extraordinary variety of marine life.
- Snorkel off one of the stunning beaches and onto the Great Barrier Reef.
- Join your guide for nature walks, reef walks and stargazing.
- Participate in the CoralWatch citizen science program and enjoy behind-the-scenes access to Heron Island Research Station.
- See green turtles and loggerhead turtles nesting on beaches.
- Spend two nights on Wilson Island.

EXCLUSIVE
Monitor green turtles (*Chelonia mydas*) and loggerhead turtles (*Caretta caretta*) nesting.

EXPERT GUIDE

Susy James

Susy is a CoralWatch ambassador and Reef Check Australia surveyor with a deep passion for ocean conservation. When she's not travelling and working on the Great Barrier Reef, Susy spends her time volunteering for various marine organisations in Byron Shire in northern New South Wales, where she resides.

DEPARTURES & FARES

Duration: Six days

Group Size: Maximum 10 people

Activity Level: Easy to moderate

Departing:
3 November 2025
1 December 2025

Prices:
From $5490pp twin share
From $7290pp single

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AUSQUIZ

How much do you really know about Australia? Test yourself!

1 **True or false: koalas are native to Western Australia.**

2 In what year did the Gold Coast host the Commonwealth Games?

3 **Which native marsupial has suffered population declines because of facial tumour disease?**

4 Is the Australian Capital Territory an enclave within New South Wales or Victoria?

5 **What was the first dam built on the Murray River?**

6 Which Australian native is the world's tallest flowering plant?

7 **The Australian Armour & Artillery Museum is located in which state or territory?**

8 Which river, thought to be the world's oldest, 'flows' through the Northern Territory and South Australia?

9 **Are pythons venomous or non-venomous?**

10 The yellow-throated honeyeater (*Lichenostomus flavicollis*) is endemic to which state or territory?

11 **What was convict Francis Greenway's profession in the New South Wales colony?**

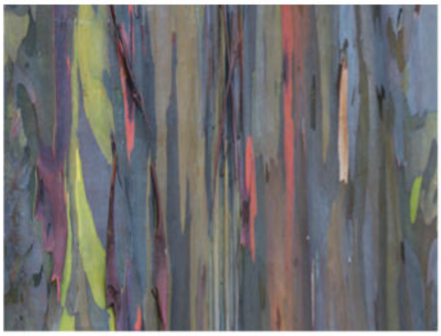
12 Is Kati Thanda–Lake Eyre a salt or freshwater lake?

13 ***Vombatus* is the genus of which Aussie marsupial?**

14 Which Aussie state is known as the 'Garden State'?

15 **What is the First Nations name for Hobart?**

16 What is Australia's largest species of land snail?



17 **Christmas Island is located in which ocean?**

18 What is Australia's smallest bat species?

19 **What is the southernmost point of mainland Western Australia?**

20 In which war did the Imperial Camel Corps serve?

21 **What is Australia's largest exclusively freshwater fish species?**

22 Which art movement was Australian painter James Gleeson associated with?

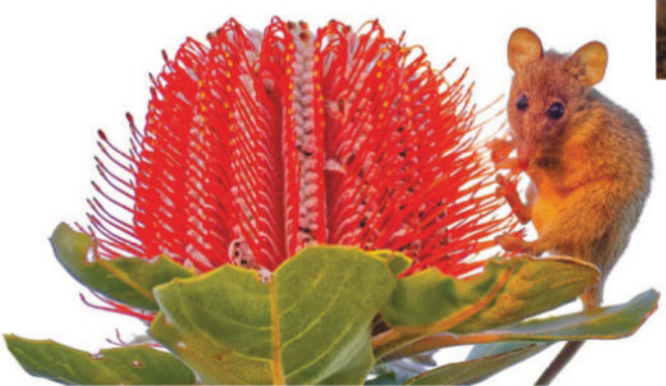
23 **What is Australia's national floral emblem?**

24 In what year was Julia Gillard sworn in as Australia's first female prime minister?

25 **What is the largest national park in New South Wales?**

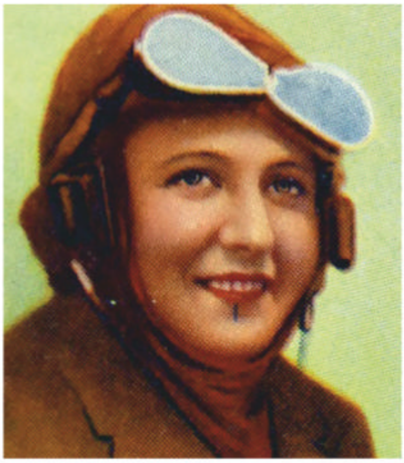
26 What is the largest island in Bass Strait?

27 ***Hemiscyllium ocellatum* (above) is more commonly known by what name?**

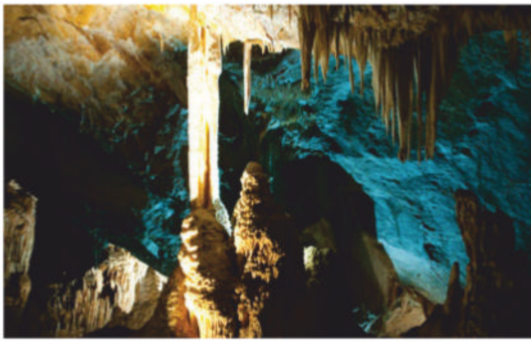


28 **What is the common name of this tree (left) known for its colourful bark?**

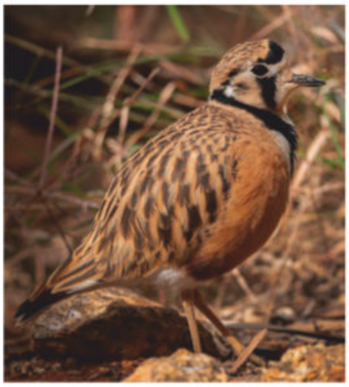
29 **This aviator was the first woman to circumnavigate Australia by plane. What is her name?**



30 **What is the name of this NSW cave complex?**



31 **What is the common name of this bird?**



32 **What is the common name of this marsupial?**

FOR ANSWERS See page 128 ▶

PHOTO CREDITS, CLOCKWISE FROM TOP: GETTY IMAGES; ALAMY; ALAMY; ALAMY; ALAMY; ALAMY; ALAMY

In the 19th century the Foxhunters Return was a coaching inn, providing accommodation for well-to-do travellers.

Campbell Town, TAS

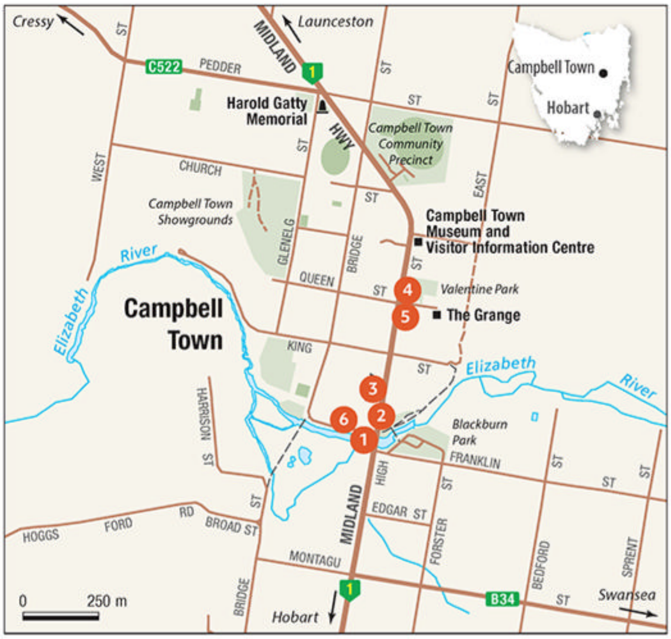
This charming town in the heart of Tasmania is steeped in history at every turn.

THIS QUAINT TOWN, often used as a halfway stopping point between Hobart and Launceston, has dozens of buildings dating back to the 19th century. Its superb collection of Georgian and Victorian structures includes a Gothic manor named The Grange Estate; a former coaching inn turned private residence and bookshop called the Foxhunters Return; and the handsome, convict-built Red Bridge. It's a town you can experience simply by wandering up and down its main street, the Midland Highway, and taking a stroll along the Elizabeth River.

Campbell Town's 200-year history features some genuinely fascinating moments commemorated by various monuments throughout the town. Inside Valentine Park, in front of The Grange, there's a statue of Tasmania's wool industry pioneer Eliza Forlonge, who brought Saxon merino sheep to the district in the early 1830s. The park also has a sundial that was erected to celebrate the 1874 and 2004 transits of Venus. In 1874, Campbell Town was one of eight places worldwide chosen by the US Naval Observatory to observe and record the astronomical event. Dr William Valentine, who lived at The Grange, hosted the observing party.

Further up the highway is a memorial to navigator and aviator Harold Gatty, born in Campbell Town in 1903. In 1931, Gatty and American aviator Wiley Post flew around the world in the *Winnie Mae*. Their record-breaking flight lasted 8 days, 15 hours and 51 minutes.

BRUCE ELDER


Cressy
Launceston
C522
PEDDER
MIDLAND
HWY
1
ST
Campbell Town
Hobart
Harold Gatty Memorial
Campbell Town Community Precinct
CHURCH
WEST
EAST
Campbell Town Showgrounds
GLENELG
BRIDGE
Campbell Town Museum and Visitor Information Centre
QUEEN
Elizabeth
River
Campbell Town
4
5
Valentine Park
The Grange
KING
HARRISON ST
3
2
6
1
Blackburn Park
FRANKLIN
HIGH
EDGAR ST
FORSTER
HOGGS
FORD
RD
BROAD ST
MONTAGU
BEDFORD
SPRENT
0
250 m
Hobart
B34
Swansea

Campbell Town is a 67km drive south-east of Launceston and a 133km drive north of Hobart via the Midland Highway.

ORIGIN OF NAME

The town takes its name from Elizabeth Macquarie, née Campbell, the second wife of Governor Lachlan Macquarie.

VISITOR INFORMATION

Campbell Town Museum and Visitor Information Centre,
75 High Street, Campbell Town. **Phone:** 03 6381 1353.
Open 10am–3pm, except Fridays and Sundays.

USEFUL WEBSITE

tasmania.com/points-of-interest/campbell-town

PHOTO CREDIT: TOURISM TASMANIA

Places of interest

1 RED BRIDGE

The foundation stone for this three-arch bridge was laid by Lieutenant Governor George Arthur on 21 October 1836. Completed in July 1838, the convict-built structure features distinctive red bricks handmade from local clay, giving the Red Bridge its enduring character and name. It's Australia's oldest surviving brick arch bridge still in use on a major highway.

2 THE CHAINSAW SCULPTURES

Carved from three trees by Tasmanian chainsaw artist Eddie Freeman, these sculptures depict notable moments from Campbell Town's history. One shows a British soldier guarding a convict labourer building the Red Bridge, as well as bushranger Martin Cash. Another features Dr William Valentine with a telescope, marking the 1874 transit of Venus, alongside an aircraft and globe honouring aviator Harold Gatty. A sheep and fleece represent the Campbell Town Show, the longest-running agricultural show in the British Commonwealth. The third tree features local wildlife seen along the Elizabeth River.

3 THE CONVICT BRICK TRAIL

Along the west side of the Midland Highway, there's a long, single line of red bricks running along the pavement. Carved into each brick is the name of a convict, their age, the year they arrived in Australia, the ship they were transported on, their crime and their sentence.

4 THE TRANSIT OF VENUS SUNDIAL

This sundial in Valentine Park was designed and built by Anthony Sprent using old agricultural machinery in the town. It commemorates the transits of Venus during both 1874 and 2004.

Red Bridge (above) spans the Elizabeth River. In nearby Valentine Park, a sculpture (below) commemorates wool pioneer Eliza Forlonge.

5 ELIZA FORLONGE STATUE

Also in Valentine Park is the sculpture *Eliza & The Ram*. The statue celebrates Eliza Forlonge (1784–1859), a wool pioneer who left Scotland for Saxony, Germany, in 1829 with an ambitious plan: to buy the best Saxon merino stock she could find and take it to Australia. She arrived in Van Diemen's Land (now Tasmania) in 1831 and went on to establish the colony's superfine wool industry. Today, the original bloodlines of her flock still produce some of the world's finest wool.

6 THE FOXHUNTERS RETURN

This coaching inn was built in the 1830s by Irish master stonemason Hugh Kean with the help of convicts. The National Trust describes it as "the finest and most substantial hotel building of the late colonial period in Australia". Its cellars have been converted into a trendy bookshop called The Book Cellar, which is open Monday to Friday from 10am–4pm.

Campbell Town timeline

- Before European settlement, the area was the home to the Tyerrernotepanner First Nations peoples.
- **In 1811 Governor Lachlan Macquarie toured the colony of Van Diemen's Land. Travelling from Hobart to Launceston, he named the river passing through what is now Campbell Town 'Elizabeth', in honour of his wife.**
- District constable Thomas Kenton became the site's first European settler in 1819. He lived in a log cabin beside the river.
- **Governor Macquarie established a garrison town next to the Elizabeth River. He named it Campbell Town in May 1821.**
- A causeway made from logs and earth was built across the Elizabeth River in 1822.
- **The town site was surveyed by Thomas Scott in 1823.**
- The Campbell Town police district was established in 1827. A gaol, magistrate's court and gaoler's house were built.
- **In the early 1830s Eliza Forlonge arrived in the area with a flock of Saxon merino sheep. Eliza helped forge Campbell Town's reputation as the centre of Van Diemen's Land's superfine-wool industry.**
- Convicts finished building the Red Bridge in 1838.
- **The first Campbell Town Show was held in 1839 and has continued until today. Locals proudly claim it's the oldest agricultural show in the British Commonwealth.**

Since 1988 Bruce Elder has travelled to every town in Australia. He has written more than 10 travel books, including the Globetrotter Guides to Australia, Sydney and Queensland; *1015 Things to See and Do in Australia*, *Explore Queensland* and *Explore NSW*. He worked as a full-time travel writer with *The Sydney Morning Herald* and *The Age* from 1996 to 2012. *aussietowns.com.au*

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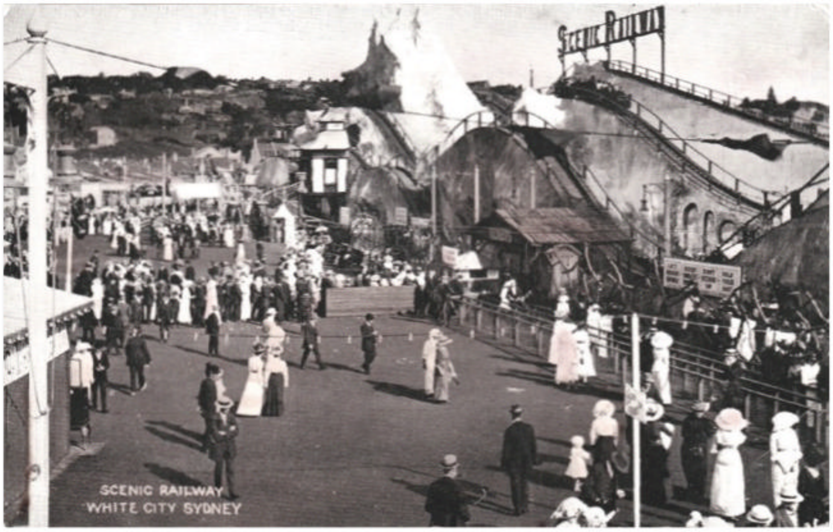
TRACES

BY ESME MATHIS

NSW
WHITE CITY

White City, NSW



After fire destroyed White City Amusement Park (above) in 1917, the site was redeveloped into NSW's premier tennis venue, where legends such as Lleyton Hewitt (left) played.

THE NAME WHITE City would be familiar to Aussie tennis fans. For almost 80 years, this open-air site in the inner-Sydney suburb of Paddington was the premier tennis venue in New South Wales. Less well-known is that it took its name from an all-but-forgotten amusement park that was as spectacular as it was short-lived.

The White City Amusement Park operated for just four years, from 1913–17. It was built by T. H. Eslick, an eccentric Englishman with an impressive (and possibly exaggerated) portfolio of amusement parks and ballrooms worldwide. He helped design Melbourne's Luna Park and built a second White City Amusement Park in Perth, which operated until 1929.

Sydney's White City was a roaring success, drawing tens of thousands of visitors each day in summer (the only time of year it was open). Its attractions included a scenic railway (rollercoaster), Ferris wheel, shoot-the-chute and carousel, as well as promenade concerts, carnival games and sideshows. The park was visually striking – think tall white buildings strung with fairy lights and immersive scenery such as mountains, lakes and fountains.

Contemporary newspapers published glowing editorials about the park and its amusements. "The merry go round, the captive flying machines, the crystal tangle and a hundred side-shows, from hoopla to the assassination of the Kaiser with a cricket ball, provided infinite amusement," reported *The Farmer & Settler* on 15 December 1914. The park also hosted masquerade balls and fancy-dress carnivals.

Entertainers including aerial trapeze artists and tightrope walkers were hired. One was fire diver Marie Thelin, who thrilled audiences by setting her clothes alight and jumping 20m below into a tank of water. *The Tweed Daily* described the act on 10 January 1914: "The huge crowd was hushed as the intrepid girl made her leap, and swept like a flaming comet from the sky into the tank below." But the act didn't always go as planned; less than two weeks later, *The Bathurst Times* reported Marie Thelin "narrowly escaped death last night" after "her costume ignited before she was ready", prompting her to hit the water heavily and become unconscious.

White City Limited went into voluntary liquidation in December 1917 after a lightning strike caused a fire that spread quickly and destroyed its timber buildings. Eslick appears to have parted on bad terms with the company's shareholders: on 23 December he took out an advertisement in *The Sun* to promote his upcoming New Year's Eve Fancy Dress Carnival – and refute "exaggerated" rumours about his character. He confirmed he wasn't dead, bankrupt or in jail, and he certainly hadn't "cleared to America with the White City's takings". Eslick concluded: "The White City story's just silly – they wouldn't let me get near the takings...I'm not in gaol, but if I ever get there I'll cheer the boys up a bit inside."

After White City Limited went into liquidation the site was considered for a housing scheme, but in October 1920 it was bought by the NSW Lawn Tennis Association (now Tennis NSW) for £13,600 (about $1.16 million today). The tennis venue was built in 1922 and went on to become NSW's premier tennis arena. For almost 80 years, the open-air tennis centre hosted prestigious tournaments including the Davis Cup, Australian Open, and NSW Amateur and Open championships.

When Sydney Olympic Park Tennis Centre opened for the 2000 Summer Olympics, Tennis NSW relocated to Homebush, and White City's historical grandstands and tennis courts soon fell into disrepair. Throughout the 2000s, the Woollahra Council rejected development applications for the site, recognising its heritage value. In 2010 it was bought by the Hakoah Club, which has since demolished its main grandstand and clubhouse to build a modern gym and tennis venue.

MORE INFO: *visitsydneyaustralia.com.au/lost-theme-whitecity.html*

PHOTO CREDIT (BOTTOM): GETTY IMAGES

AUSQUIZ ANSWERS

1) False **2)** 2018 **3)** Tasmanian devil (*Sarcophilus harrisii*) **4)** NSW **5)** Hume Dam **6)** Mountain ash (*Eucalyptus regnans*) **7)** Queensland **8)** Finke River/Larapinta **9)** Non-venomous **10)** Tasmania **11)** Architect **12)** Salt **13)** Wombats **14)** Victoria **15)** Nipaluna **16)** Giant panda snail (*Hedleyella falconeri*) **17)** Indian Ocean **18)** Little forest bat, or little forest bangu (*Vespadelus vulturnus*) **19)** Torbay Head (in West Cape Howe NP) **20)** World War I **21)** Murray cod (*Maccullochella peelii*) **22)** Surrealism **23)** Golden wattle (*Acacia pycnantha*) **24)** 2010 **25)** Kosciuszko NP **26)** Flinders Island **27)** Epaulette shark **28)** Rainbow eucalyptus (*Eucalyptus deglupta*) **29)** Maude Rose 'Lores' Bonney **30)** Jenolan Caves **31)** Inland dotterel (*Peltohyas australis*) **32)** Honey possum (*Tarsipes rostratus*)

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